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NEW GENERA AND NEW SPECIES OF FOSSIL TERRESTRIAL MOLLUSCA FROM BRAZIL

By CARLOTTA JOAQUINA MAURY

The stratigraphic ranges of terrestrial Mollusca in South America are as yet largely unknown, and very few index species have been determined. But in Brazil fossil land shells have lately been described by the writer from subaerial, calcareous breccia at Almino Affonso, south-west of Patú, Rio Grande do Norte, and assigned to the Pleistocene.¹ And the present paper describes fossil terrestrial mollusks from Fazenda São José, State of Rio de Janeiro, and from Iporanga, State of São Paulo, and discusses their stratigraphic horizons.

The collections herein described were sent to the writer by Dr. Euzébio de Oliveira, Director of the Geological Survey of Brazil, with permission to publish. The illustrated type specimens accompanying this paper are deposited in the Department of Geology and Invertebrate Palaeontology, American Museum of Natural History, Dr. Chester A. Reeds, Curator. The illustrations have been drawn by Mr. George S. Barkentin.

In describing the Brazilian fossil land shells we are greatly indebted for the advice and decisions of Dr. Henry A. Pilsbry, Curator of Mollusca, Philadelphia Academy of Sciences, the world authority on terrestrial mollusks.

1. THE TERRESTRIAL FOSSIL MOLLUSCA FROM FAZENDA SÃO JOSÉ ITABORAHY, STATE OF RIO DE JANEIRO

A collection of fossil terrestrial Mollusca of great palaeontological and stratigraphical interest was made by Dr. A. Lamago, of the Geological Survey of Brazil, at Fazenda São José, Municipality of Itaborahy, State of Rio de Janeiro. Associated with the shells was a crocodilian jaw.

An earlier collection was made by Dr. Luciano Jacques de Moraes at Fazenda Ernesto Coube, very near the present locality, but the only identifiable form was the base of a *Strophocheilus* assigned from its

¹Maury, Carlotta J. 1931. 'Fossil Invertebrata From Northeastern Brazil' Bulletin American Museum of Natural History, LXVII, Article 1, pp. 107-170, Pl. XVII, figs. 1, 2, 3.

general aspect to the Tertiary.¹ My decision is now corroborated by the well preserved shells in the new collection.

The formation at Fazenda São José is a very pure limestone, almost entirely free from magnesium.² It is used for the manufacture of Portland cement at Guaxindiba. The matrix is light-yellow and the enclosed shells cream-white. It is sometimes oölitic or pisolitic. A thin section sent by Dr. Oliveira shows beautifully the very fine, concentric layers of which the oölites are composed. This oölitic and pisolitic *facies* of the Fazenda São José limestone recalls the similar but very much older oölitic limestone of the State of Sergipe.³ The São José oölites are Tertiary while the Sergipe oölites are Cretaceous.

The Fazenda São José limestone lies directly upon the crystalline rocks. It is surrounded by, and cradled in Archean gneiss. The only other sedimentaries in the region are of late Quaternary age.⁴ The fossils in this limestone are so very unlike the land shells now living in Brazil that they suggest a Miocene age, with an uppermost limit of Pliocene. In Dr. Lamago's small collection there are actually two new genera, one allied to an African type but unlike any genus now living on the American continents. This startling change points to Miocene rather than to Pliocene, since Pliocene forms are not so very different from the Recent. But we know as yet so little of the stratigraphic ranges of land shells in South America that the age *may* be as young as Pliocene, to which the São José limestone is referred in Dr. Oliveira's latest generalized geological section of Brazil.⁵

A photograph of the crocodilian jaw shows eight teeth, is not quite complete but measures 100 millimeters in length. Dr. Charles C. Mook, of the American Museum of Natural History, who has specialized on crocodilians, kindly passed judgment upon this, and states that it resembles the living genus *Jacaretinga*, and is nearest to *J. latirostris* in form, and that it is probably a Miocene or Pliocene relative of *Jacaretinga latirostris*.

The genus *Jacaretinga* was created by Spix⁶ in 1825, with *J. moschifer* and *J. punctulatus* as genotypes. *Jacaretinga latirostris* was described

¹Maury, Carlotta J. 1929. 'Novas Collecções Paleontológicas do Serviço Geológico do Brasil.' Fosséis Terrestres Terciários do Estado do Rio de Janeiro. Boletim, N 33, Serviço Geológico e Mineralógico do Brasil, pp. 4-7.

²Oliveira, Dr. Eusebio de. 1934. *In litteris*.

³Maury, Carlotta J. 1934, in press. 'O Cretaceo de Sergipe' Monographias do Serviço Geológico e Mineralógico do Brasil, XI.

⁴Oliveira, Dr. Eusebio de. 1934. *In litteris*.

⁵Oliveira, Dr. Eusebio de. 1933. 'Geologia Historica do Brasil.' Columna Geologica organizada de accordo com os estudos feitos até 31 de Dezembro de 1932. Pagina 1. Rio de Janeiro

⁶Spix, Joannes Baptista de. 1825. 'Animales Nova sive Species Novae Lacertarum quas in Itinere per Brasiliam Annis MDCCCXVII-MDCCCXX Jussu et Auspiciis Maximiliani Josephi I. Bavariae Regis suscepto collegit et descripsit Dr. J. B. de Spix,' p. 1. See also pp. 2, 3 and Tables I, II.

by Spix¹ as *Caiman fissipes* found by him in pools along Rio São Francisco. The specific name *fissipes* fell under synonymy of *latirostris*, given twenty-three years earlier by Daudin.² Drs. Mook,³ Schmidt,⁴ and Werner⁵ give recent descriptions of *Jacaretinga latirostris* Daudin. The skull is very broad and short; the animal attains a length of two meters or more, and when adult is uniformly of a dark olive-green color. In Brazil it is living in the States of Pernambuco, Bahia, Minas Geraes, São Paulo, Rio Grande do Sul, and is also in Paraguay and Argentina.

The remains of the Miocene or Pliocene ancestral precursor of this crocodilian are fossilized in the Fazenda São José limestone.

MOLLUSCA

STREPTAXIDAE

PTYCHOTREMATINAE

(Genus *Brasilennea*, gen. nov.)

In the light-yellow limestone of Fazenda São José are beautifully preserved, elegantly sculptured terrestrial shells representing a new genus and species. Dr. Pilsbry has kindly examined the specimens and states⁶ that the shell is a totally new type for America, being related to the African genus *Ptychotrema* and nearest to *Ennea*, a subgenus of *Ptychotrema*. He adds that it differs from both *Ennea* and *Ptychotrema* by the presence of a parietal lamella, while in those genera only the angular lamella is developed; also by the straight parietal margin of the peristome.

The new generic name is compounded by *Ennea*, the form most closely allied, and the country of Brazil, because this is the first occurrence known on the American continents of a shell of this typically Old World race.

Some sixty recent species of *Ennea* are living in Africa, Madagascar, Mauritius, India, Ceylon, and Formosa. In view of this Indo-African distribution, the statement of Bland⁷ that *Ennea bicolor*, in 1861, was living on the Island of St. Thomas, West Indies, and had also been discovered by Theodore Gill on Trinidad, West Indies, is very striking.

¹Spix, *Loc. cit.* pp. 1-5, Table III. (Drawing of entire animal, reduced.)

²Daudin, 1802. *Hist. Rept.*, II, p. 417. (As *Crocodilus latirostris*.)

³Mook, Charles C. 1921. *Bulletin American Museum Natural History*, XLIV, p. 288. (As *Jacaré latirostris*.)

⁴Schmidt, Karl P. 1928. *Publications Field Columbian Museum, Chicago. Zoology*, XII, p. 216. (As *Caiman latirostris*.)

⁵Werner, Franz. 1933. 'Das Tierreich,' 62. Lieferung. Reptilia. Loricata. Berlin and Leipzig. pp. 29-30, fig. 29 (skull only). (As *Jacaretinga latirostris*.)

⁶Pilsbry, Henry A. 1931. *In litt.*

⁷Bland, Thomas. 1861. 'The Distribution of the Genera and Species of Land Shells of the West Indian Islands.' *Annals Lyceum of Natural History, New York*, VII, pp. 15, 21, 22, Tables I, II. See also *idem*, VI, p. 117.

But no Antillean specimens are catalogued in the Bland collection. Moreover, *Ennea bicolor* Gould has been assigned by Dr. Pilsbry¹ to the section *Indoennea* of Kobelt. *Ennea* was created about eighty years ago by H. and A. Adams² and has not been cited from the American continents. The Brazilian fossil new genus, *Brasilennea*, in general aspect resembles somewhat *Ennea cerea* Dunker, 1855, especially the specimen figured by Tryon³ with strong sculpture, but a shell in the American Museum from Zanzibar does not have at all the pronounced ribbing of our fossil and of Tryon's figure.

The genus *Ptychotrema* Morch, 1852, is characteristically African in distribution.

Dr. Lamengo's discovery of the Brazilian fossil shells is the first trace of a related though distinct genus on the American continents.

The description of the genotype and only species yet known is as follows:

***Brasilennea arethusae*, sp. nov.**

Figs 1, 2 and 4: Holotype, Amer. Mus. No. 24237.

Fig 3: Cotype, Amer. Mus. No. 24238.

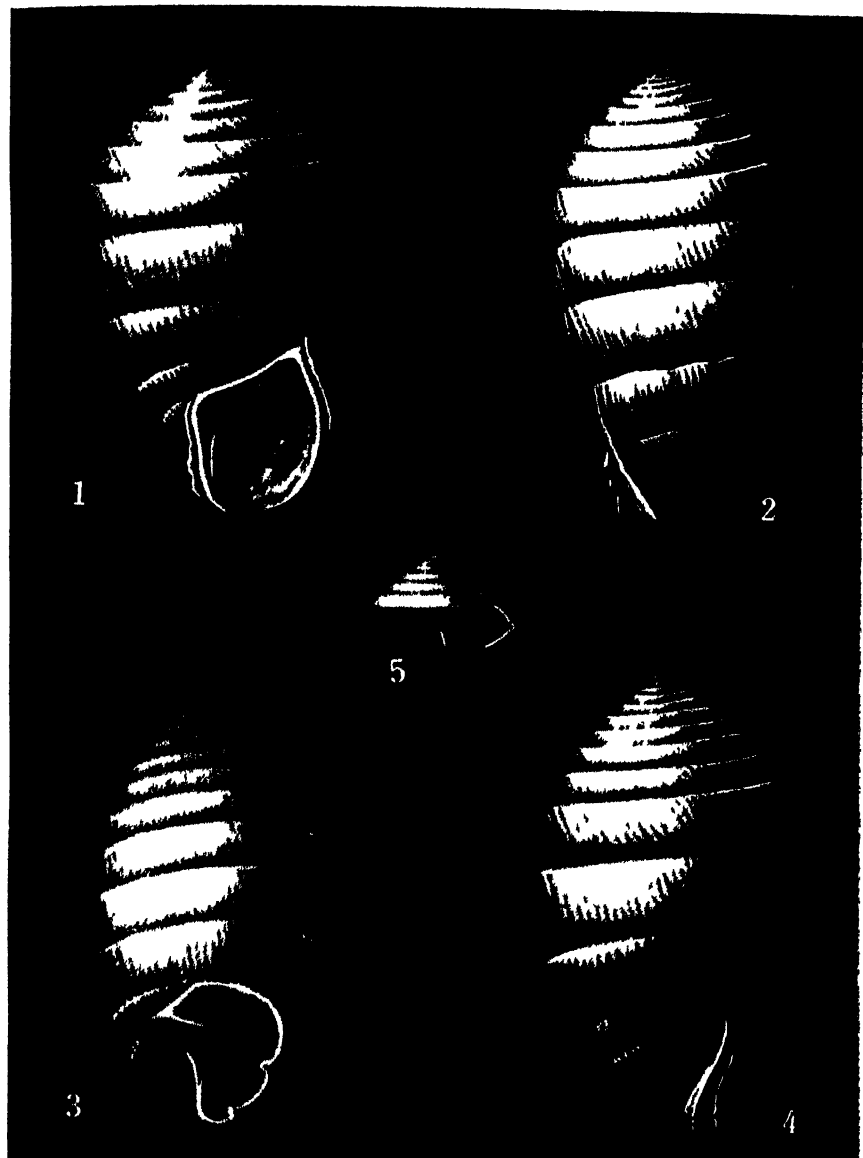
Fig 5: Cotype, Amer. Mus. No. 24239

Shell of medium size, the adult form convexly subcylindrical with the greatest breadth near or a little above the center of the shell. Volutions many, with their sides convexly flattened. Sutures linear and distinct. Apex of the shell obtusely pointed, but only very slightly elevated. The first two-and-a-half to three whorls are smooth, glossy, with their sides gently convex. Thereafter the subsequent whorls become more and more strongly sculptured with very fine, narrow, closely-set, sharply-defined ribs, which on the center of the shell number nearly three to a space of one millimeter. There is a graceful change in the direction of the trend of the ribbing, the ribs on the spire being very oblique, but those on the last volution are almost vertical. In the adult shell the last whorl narrows markedly, and on the aboral side shows two strong external sulci, one central, the other basal and defining the conspicuous perforation of the shell. Aperture with two pronounced folds within. One fold is on the columella, well shown on one specimen to be strong and rounded, while the other fold is sharper and is on the upper inner margin of the aperture, nearly median. Outer lip straight, with a parallel lamella on a perfect shell. Height of adult shell 25 mm., greatest width

¹Pilsbry, Henry A. 1919 'A Review of the Land Mollusks of the Belgian Congo Expedition 1900-1915' Bulletin American Museum of Natural History, XL, p. 223

²Adams, H. and A. 1855 'Genera Recent Mollusca' II, p. 171

³Tryon, George. 1884 'Structural and systematic Conchology,' III, p. 17



Figs. 1, 2 and 4. *Brasilennia arethusae*, gen. and sp. nov. $\times 2\frac{1}{2}$. Amer. Mus. No. 24237, holotype.

Fig. 3. *Brasilennia arethusae*, gen. and sp. nov. $\times 2\frac{1}{2}$. Amer. Mus. No. 24238, cotype.

Fig. 5. *Brasilennia arethusae*, young shell. $\times 2\frac{1}{2}$. Amer. Mus. No. 24239, cotype.

14 mm.; height of aperture measured obliquely, 9 mm., greatest width of aperture 7 mm.

In addition to the adult shells, there are several young shells proved by their sculpture and form of the upper portion to be adolescent members of this species, although they are strikingly unlike the adult shells in form. The young shells are subdiscoidal, widest at the base, the last whorl having the greatest diameter. The first two or three volutions are smooth, while the upper surface of the following volutions bears fine, oblique costae. On the body whorl of the adolescent shells the costae terminate suddenly at the sharply angulate periphery of the whorl, the under surface being smooth except for microscopic growth lines. The aperture is angulated by the sharp periphery, and the perforation is deep. One young shell measures 4 mm. in height and 7 mm. in greatest diameter: another is 6×9 and includes about seven whorls.

This species is dedicated to the sylvan nymph, Arethusa, in reference to the terrestrial habits of this very interesting Brazilian mollusk.

LOCALITY.—Fazenda São José, Municipality of Itaboraí, State of Rio de Janeiro, Brazil. In a pure, light-yellow limestone.

HORIZON.—Probably Miocene, but possibly as young as Pliocene.

ACAVIDAE

STROPHOCHEILINAE

Genus *STROPHOCHEILUS* Spix

The genus *Strophocheilus* was created by Spix¹ more than a century ago in a delightful old volume describing his scientific expedition through Brazil under the auspices of the King of Bavaria. Spix collected terrestrial, marine and freshwater shells, and oversaw the drawings but died before the text was ready for publication, and the descriptions were completed by J. A. Wagner.

The genotype is *Strophocheilus pudicus* Müller (= *S. almeida* Spix)². A remarkable character of the genus *Strophocheilus* is the production of large, oblong or oval, hard-shelled, white eggs. The only other living genera producing similar large eggs are *Panda* of Australia, *Helicophanta* of Madagascar, and *Acavus* of Ceylon. Because of the apparent relationship of the large-egged mollusks, *Strophocheilus* is

¹ Spix, Joannes Baptista de 1827. In Wagner, J. A. 'Testacea Fluvialilis quae in itinere per Brasiliam Annis MDCCCXVII-MDCCCXX Jussu et Auspiciis Maximiliani Josephi I Bavariae Regis Austriacae suscepto collegit et pingenda curavit Dr J B de Spix.' Edited de Schrank and de Martius, p. 12, Pl. XI.

² Vide Reeve, Lovell A. 1849 'Conchologia Iconica,' V, *Bulimus*. Species 191 is a specimen collected by Spix in Brazil of *Strophocheilus almeida* Spix, placed by Reeve in synonymy of *Bulimus pudicus* Muller.

placed in the family Acavidae.¹ *Acavus* Montfort, 1810, is brilliantly colored with a red, lilac, or jet black lip, and the young on escaping from the large egg are about one-third the size of the adult. Habits arboreal.

Strophocheilus ranges through temperate and tropical South America and some adjacent islands. On the continent it is chiefly east of the Andes.

***Strophocheilus sancti-josephi*, sp. nov.**

Figures 8, 9: Holotype, Amer. Mus. No. 24241.

Shell rather large, exceeding in size any of the associated land mollusks in the collection from Fazenda São José, and broadly ovate in form. The early whorls are not preserved but the shell when entire included about seven whorls. The surface is much worn and eroded, but in a few small areas fine, oblique wrinkles of growth are preserved and the entire surface was probably similarly striated. The aperture is narrowly oval. Estimated length of complete shell 45 mm., greatest width 27 mm.; length of aperture measured obliquely 24 mm., greatest width of aperture 10 mm.

Although poorly preserved, this shell is so unlike any associated species in the limestone that it can be easily recognized by its broad, ovate form and comparatively large size. It was judged by Dr. Pilsbry to be a new species.

LOCALITY. Fazenda São José, Municipality of Itaboraí, State of Rio de Janeiro. In a pure, light-yellow limestone.

HORIZON. Probably Miocene, with an extreme upper limit of Pliocene.

BULIMULIDAE

Genus **BULIMULUS** Leach

Leach described the genus *Bulimulus*² about a hundred and twenty years ago, the genotype being *Bulimulus exilis* (Gmelin). This genus first appeared in Mid-Tertiary time. Its present geographical range is from Argentina and Chile through Brazil and north to Arkansas and Tennessee, North America. The favorite habit of living of the species is on the ground or on low herbage, or shrubs.

***Bulimulus fazendicus*, sp. nov.**

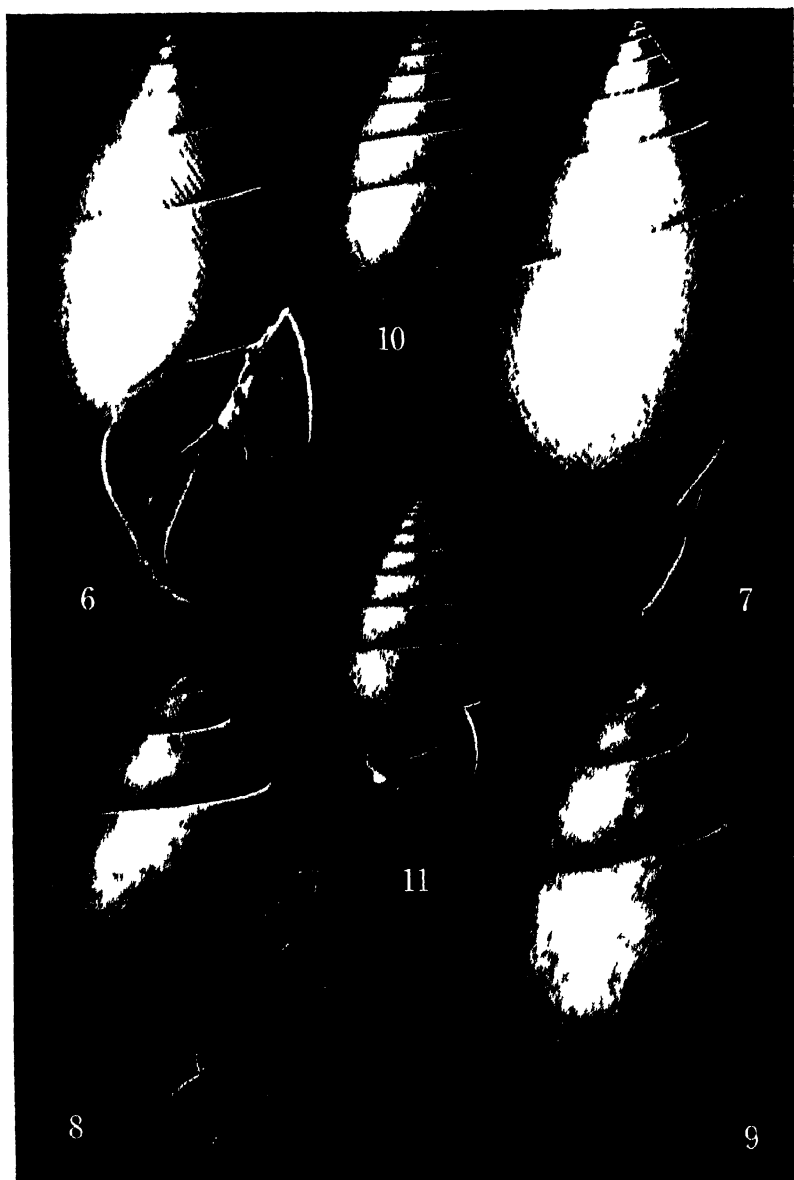
Fig. 10: Cotype, Amer. Mus. No. 24242.

Fig 11: Holotype, Amer. Mus. No. 24243.

Shell small for the genus, conic-pyramidal in form, perforate, very neat and trim in appearance; remarkable for its many and very narrow

¹Fulton, Hugh C. 1925. 'Catalogue of Land Shells,' p. 29. London.

²Leach, W. E. 1815. 'Zoological Miscellany,' I, p. 41. See also Tryon and Pilsbry. 1895-6. 'Manual of Conchology,' second series, X, p. 125.



Figs. 6, 7. *Itaborahia lamegoi*, gen. and. sp. nov. $\times 2\frac{1}{2}$. Amer Mus. No. 24240, holotype.
 Figs. 8, 9. *Strophocheilus sancti-josephi*, sp. nov. $\times 1\frac{1}{2}$. Amer Mus. No. 24241, holotype.
 Fig. 10. *Bulimulus fazendicus*, sp. nov. $\times 2\frac{1}{2}$. Amer. Mus. No. 24242, cotype.
 Fig. 11. *Bulimulus fazendicus*, sp. nov. $\times 2\frac{1}{2}$. Amer. Mus. No. 24243, holotype

whorls, the adult comprising nearly nine volutions. The shell is widest near the base and tapers rapidly and evenly to the acute summit. The extreme apex formed by the earliest whorl appears, however, slightly obliquely flattened, due to its sudden increase in convexity. The earliest whorls seem entirely smooth, but one specimen shows on the third volution fine, nearly vertical striae. As a whole the shells are smooth except for microscopic, oblique wrinkles. Aperture ovate, lip thin, columella nearly straight. The most perfect shell measures in length 17 mm., of which 8 mm. are occupied by the spire and the remaining 9 mm. by the body whorl. Greatest width of shell nearly 10 mm. Length of aperture measured obliquely 6 mm., greatest width of aperture nearly 5 mm.

Dr. Pilsbry kindly examined this fossil shell and found that it was not closely related to any living member of the genus. The large number of narrow whorls is its most prominent feature.

LOCALITY.—Fazenda São José, Municipality of Itaboraahy, State of Rio de Janeiro, Brazil. In a pure, light-yellow limestone used for the manufacture of Portland cement

HORIZON Probably Miocene Possibly as young as Pliocene.

Genus *ITABORAHIA*, gen. nov.

Several of the fossil land shells in Dr. Lamego's collection from Fazenda São José, Itaboraahy, are judged by Dr. Pilsbry,¹ who kindly examined our specimens, to represent a new genus and new species of the family Bulimulidae.

The generic name, *Itaborahia*, is from the Municipality of Itaboraahy, in which the fossiliferous limestone carrying the fossil land shells occurs.

In this new genus the shell has the compact, ovate contour of *Rhinus* or *Neopetraeus*, but bears a prominent fold on the columella, and the margin of the columella is expanded so as to entirely close the umbilical crevice.

For comparison, the following notes on *Rhinus* and *Neopetraeus* may be of value. *Rhinus* was described by Albers,² in 1860, the type being *Rhinus heterotrichus* Moricand,³ found at Bahia, and at Corcovado in the city of Rio de Janeiro. *Rhinus* resembles *Bulimulus* but has a hairy, bristly cuticle that holds particles of soil for protection of the shell. *Rhinus* is especially characteristic of, and distributed through Brazil,

¹Pilsbry, Henry A. 1931. *In littens*.

²Albers, J. C. 1860. 'Die Heliceen' (Edit. E. von Martens), p. 223. Leipzig.

³Moricand, Stefano. 1836. 'Mém. de Phys. et Soc. d'Hist. Nat. Genève, VII, pt. 2, p. 430, Pl. II, figs 5, 6. (As *Helix* [*Cochlogena*] *heterotricha*). See also Reeve, 'Conchologia Iconica,' *Bulimus*, Pl. XXXII, fig. 199, Tryon and Pilsbry, 1897-8. 'Manual of Conchology,' second series, XI, pp. 74-76, Pl. XIII, fig. 1, Pl. XIII, fig. 16.

but extends also into Venezuela. *Neopetraeus* of von Martens,¹ 1885, genotype *N. millegranus* von Martens,² is characteristically Peruvian, in the valley of the Marañon, in very hot, sterile localities

The characters of the genotype and only species yet known of the new Brazilian genus, *Itaborahia*, are as follows:

***Itaborahia lamegoi*, sp. nov.**

Figures 6, 7: Holotype, Amer. Mus. No. 24240.

Shell of medium size, broadly fusoid to bi-conic in form, compact, robust and solid in aspect. Whorls seven or eight in number, tapering rapidly to the acute summit. The earliest volutions are not preserved in our specimens, but on the third whorl very fine ribbing commences. The subsequent whorls of the spire and the entire body whorl are delicately sculptured with very fine, microscopic, closely-set, narrow, cord-like riblets, with an oblique trend. Aperture rather narrow, acuminate above and acutely rounded below. Columella with a single strong, oblique, entering fold. Margin of the columella expanded into a thin lamella which entirely closes the umbilical crevice. Length of entire shell 32 mm., greatest width 17 mm. Length of aperture, measured obliquely, 17 mm. Height of spire 10 mm., height of body whorl 23 mm.

This handsome new species, type and only representative yet known of the new genus *Itaborahia*, is named in honor of Dr. A. Lamego, of the Geological Survey of Brazil, by whom it was collected.

LOCALITY.—Fazenda São José, Municipality of Itaborahy, State of Rio de Janeiro, Brazil. In a pure, light-yellow limestone, the enclosed fossils being cream-white.

HORIZON.—Assigned tentatively to the Miocene, since the fauna is so very different from the recent. The extreme upper limit would be Pliocene, but in general Pliocene faunas do not differ so greatly from the modern.

II. THE TERRESTRIAL FOSSIL MOLLUSCA FROM NEAR IPORANGA, IN THE VICINITY OF RIBEIRA DO IGUAPE, STATE OF SÃO PAULO

Two species of fossil land Mollusca were collected by Dr. Othon Leonardos, of the Geological Survey of Brazil, near Iporanga, in the vicinity of Ribeira do Iguape, State of São Paulo, Brazil.

The matrix in which the shells are embedded is a porous, blue-gray, calcareous material that effervesces freely with dilute hydrochloric acid and contains many small, irregular cavities. It has rather the aspect of a

¹Martens, E. von. 1885 'Conchologische Mittheilungen,' I, p. 194. See also Tryon and Pilsbry, 'Manual of Conchology,' second series, XI, p. 170, Pl. xxxi, figs. 24-27, XIV, p. 132.

²Martens, E. von. *Loc. cit.*, p. 177, Pl. xxxii, figs. 1-4.

consolidated marl. This fossiliferous, impure limestone is said by the Brazilian Bureau of Mines to occur loose, not *in situ*, at the headwaters of Rio Cotia Grande, on the left bank of Riberia do Iguaçu, along the roadside from Sítio da Lagôa to the mouth of Rio Pardo, at about six kilometers from the latter locality. This area is occupied by the São Roque Series of graphitic, metamorphic, crystalline limestones and marbles. The trend of this zone becomes increasingly eastward towards Furnas or Iporanga, the strike finally being N70° E. But near Morro do Descalvado it deviates to N30° E. The dip is 40° to 45° N. Dr. Oliveira, Director of the Geological Survey of Brazil, thinks that the erratic limestone boulders of the headwaters of Rio Cotia Grande (Iporanga) were formed in the interior of caves, or in joints, of the São Roque Series.

Dr. Othon Leonardos¹ has just published a full description of the São Roque Series, with a discussion of the age of the series which he regards as younger and less metamorphosed than the rocks of the Archean Complex. Very interesting photoengravings of outcrops are also shown by Dr. Leonardos.

Field geologists suggested the possibility that the Iporanga fossiliferous limestone might be of the same age as the limestone of Fazenda São José, Rio de Janeiro. But the shells from Iporanga, São Paulo, are very closely related to living species of Brazil, which indicates that the erratic boulders of Iporanga are decidedly younger than the limestone of Fazenda São José. The similarity of the Iporanga fossil shells to the recent fauna of the region suggests that the erratic blocks are not older than Pleistocene.

Dr. Euzebio de Oliveira has made observations of striking biological interest regarding the struggle for life and eager quest of Brazilian land shells to obtain the lime needed for their growth. He finds on lime soils these mollusks are far more abundant than on non-calcareous soils, but even on lime soils they seek pieces of limestone. And in areas where lime is scarce they devour old, dead shells. At the entrances of caves which are very common in the Xiririca-Iporanga region of São Paulo, great quantities of land shells are frequently found, having entered to feed upon the lime of the cavern walls. The Ribeirão das Ostras, which runs through the cave of Tapagem, in the Serra do André Lopes, owes its name to innumerable shells of *Strophocheilus* that have entered seeking lime, and their shells appear coated with a fresh layer during their

¹Leonardos, Othon Henry. 'Chumbo e Prata no Brasil.' Departamento Nacional da Produção Mineral. Serviço de Fomento da Produção Mineral. Boletim No. 2, pp. 71, 73, 88; Estampas 10, 12, 18, 19. Rio de Janeiro, 1934

sojourn in the cave. The same species found dead in caves may often be found living on the "sambaquis."

Sincere thanks are offered to Dr. John B. Reeside, Jr., of the United States National Museum, for advice; and to Mr. F. Stearns Mac Neil, also of the National Museum, for very skilfully freeing the shells from their hard matrix, and for determining their living allies, decisions concurred in by Dr. Pilsbry.

Genus *STROPHOCHEILUS* Spix

Group of *Strophocheilus ovatus* Müller

*Strophocheilus ovatus*¹ was so named by Müller because of its ovate form, unusual in the genus. The adult shell is large, solid, ovate, chestnut-brown, glossy, and handsome, attaining 128 × 80 millimeters in size. The lip is usually a deep crimson-rose, hence the name *Strophocheilus haemastomus* given by Spix,² who over a century ago, collected specimens at Bahia, and at São Sebastião on the coast south of Rio de Janeiro, recording of the latter: "*Habitat in sylvis prope Sebastianopolin.*" The specific name given by Spix fell into synonymy of the earlier name *ovatus* of Müller.

A fine shell of this characteristic Brazilian species was collected by d'Orbigny³ in the suburbs of Rio de Janeiro, measuring 120 × 65 millimeters.

The fossil *Strophocheilus* from near Iporanga is related to the recent *S. ovatus* and is described as a subspecies of that well-known shell.

Strophocheilus ovatus iguapensis, subsp. nov.

Fig. 12: Holotype, Amer. Mus. No. 24244.

Fig. 13: Detail of sculpture of holotype (Amer. Mus. No. 24244).

In the collection are two incomplete specimens which indicate that the shell was of the *Strophocheilus ovatus* group. Each specimen includes about five whorls; the apex of one is preserved, but the fifth whorl is deformed by pressure; the other lacks the apex but shows the ovate outline. This fragmentary shell measures 15 mm. in height and 16 mm.

¹Reeve, Lovell A. 1849 'Conchologia Iconica.' *Bulimus*. Species and figure 212. Specimen from Rio de Janeiro. See also Tryon and Pilsbry, 1895-6. 'Manual of Conchology,' second series, X, pp. 24-25, Pl. xii, figs 60, 61.

²Spix, Joannes Baptista de. 1827. In Wagner, J. A. 'Testacea Fluvialitilis quae in Itinere per Brasiliam Annis MDCCCXVII-MDCCCXX Jussu et Auspicio Maximiliani Josephi I Bavariae Regis suscepto collectae et pingenda curavit Dr. J. B. de Spix,' p. 12, Pl. xi, fig. 1. As *Strophocheilus haemastomus* Spix. But *Helix ovata* Muller, Hist. Verm., II, p. 85, is prior.

³D'Orbigny, Alcide. 1835-43. 'Voyage dans l'Amérique Méridionale.' Exécuté pendant les années 1826-33. Tome V. Troisième partie. Mollusques, pp. 299-300. Paris.

Note.—Hidalgo in 'Moluscos del Viaje al Pacifico' and in Journal de Conchyliologie, XXIII, pp. 127-131, 1875, records that the early Spanish naturalists collected in South America 211 species of land shells.

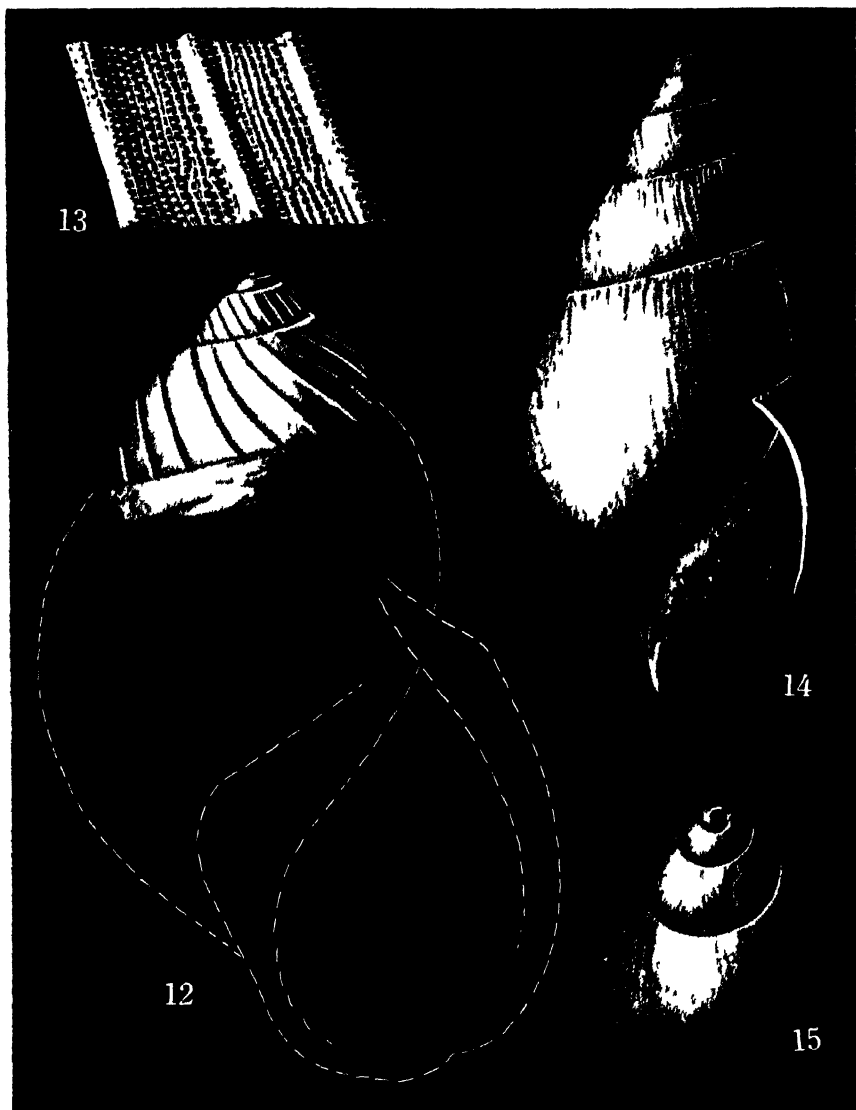


Fig. 12. *Strophocheilus ovatus iguapensis*, subsp. nov. $\times 2\frac{1}{2}$. Amer. Mus. No. 24244, holotype.

Fig. 13. *Strophocheilus ovatus iguapensis*, sculpture detail of holotype (Amer. Mus. No. 24244). $\times 10$.

Fig. 14. *Thaumastus magnificus othoni*, subsp. nov. $\times 1\frac{1}{2}$. Restoration made from Amer. Mus. No. 24245, holotype, and from Amer. Mus. Nos. 24246 and 24247, cotypes.

Fig. 15. *Thaumastus magnificus othoni*, early whorls. $\times 2\frac{1}{2}$. Amer. Mus. No. 24246, cotype.

in greatest width. The apex is rather blunt, the initial portion being very slightly sunken, and the first one-and-a-half volutions are smooth. The second and third whorls bear striking and handsome arcuate ribbing, the ribs evenly-spaced and strong. On several small areas, one being on the fourth whorl, the outer shell layer is preserved. Examined under a strong lens, these areas are seen to be covered with wrinkled, wavy striations which extend over both the ribs and their interspaces, and the striae bear extremely fine, rather sharp crenulations. This microscopic ornamentation is shown in a detailed drawing magnified ten times. These crenulations recall the granulations mentioned by d'Orbigny in *Strophocheilus ovatus*. But no traces of malleation are shown in our fossils although possibly present on the later whorls which are lacking.

The arcuate ribbing in the fossils is stronger than in any shells in the American Museum of *Strophocheilus ovatus*, but a young specimen figured by Tryon and Pilsbry of that species approaches the ornamentation of our fossils. The arcuate costae shown in Reeve's figure of *Bulimus oblongus*¹ are similar to those of our fossils.

LOCALITY.—Near Iporanga, in the vicinity of Ribeira do Iguape, State of São Paulo, Brazil. In erratic limestone boulders thought to have been formed in caves or joints of the São Roque Series of metamorphic crystalline limestones occupying this area.

HORIZON.—Probably Pleistocene.

Genus **THAUMASTUS** Albers

The distribution of the genus *Thaumastus* Albers, of the family Bulimulidae, is chiefly South American, but a few species are living in the Antilles and in California. The genotype is *Thaumastus hartwegi* Pfeiffer.

GROUP OF *Thaumastus magnificus* GRATELOUP

Thaumastus magnificus Grateloup² is a leading member of the recent terrestrial molluscan fauna of Brazil. The shell is elongated, large and handsome, shining, dark olive-green to brown, with bands of yellow at the sutures, and the aperture dark, pearly within, with a white columella.

A fossil member of the *Thaumastus magnificus* group is in the Iporanga collection.

¹Reeve, Lovell A. 1849. 'Conchologia Iconica.' *Bulimus*. *Bulimus oblongus*, Figure 210. This mollusk was said by d'Orbigny to bury itself deeply in the earth during the dry season, emerging with the advent of the rains. The life span of this species was thought by d'Orbigny to be about ten years.

²Grateloup, J. P. S. de. 1839. Actes Société Linn Bordeaux, XI, pp 165, 419, Pl iv, fig 1 (*As Bulimus magnificus*.)

***Thaumastus magnificus othoni*, subsp. nov.**

Fig. 14: Restoration from Holotype, Amer. Mus. No. 24245, and from Amer. Mus. Nos. 24246 and 24247, Cotypes.

Fig. 15: Cotype, Amer. Mus. No. 24246.

The material consists of a specimen (Amer. Mus. No. 24245) showing the general form but with apex and base lacking; a specimen (Amer. Mus. No. 24246) showing the early whorls very perfectly; and a basal portion (Amer. Mus. No. 24247) showing the aperture. The drawing is a reconstruction based on these three specimens.

Shell rather large, elongate, imperforate. Spire high with the sides of its volutions slightly convex. Summit blunt, the apex depressed and sunken. Whorls about six-and-a-half. The earliest whorl is almost smooth but shows under a strong lens exceedingly fine wrinkles parallel to a minute, oblique, terminating ridge. This early part of the shell is like a miniature *Planorbis* in form. The second whorl is delicately ornamented with fine growth lines which become stronger on the subsequent volutions. Extremely fine concentric striae may be observed on the center of the whorl. The early sutures are linear, the later slightly channeled. On approaching the aperture the suture descends a little. Aperture ovate-acuminate, rather narrow, with the outer lip thin and sharp. Columella somewhat reflexed, with a narrow callus. Estimated length of entire shell 70 mm., greatest width 28 mm. Length of aperture measured obliquely 34 mm., greatest width of aperture 15 mm.

Comparison shows that this fossil shell differs in outline from typical *Thaumastus magnificus*, the body whorl of the fossil being proportionately more slender.

This subspecies is dedicated to Dr. Othon Leonardos, of the Brazilian Geological Survey, by whom it was collected.

LOCALITY. Near Iporanga, in the vicinity of Ribeira do Iguaçu, State of São Paulo, Brazil. In erratic limestone boulders thought to have been formed in caves or joints of the São Roque Series of metamorphic, crystalline limestones occupying this area.

HORIZON.- Probably Pleistocene.

NEW SPECIES OF NYCTERIBIIDAE AND STREBLIDAE
(DIPTERA)

By C. H. CURRAN

The following descriptions are based upon a rather large collection of bat parasites submitted by Major L. H. Dunn, with the request that the new species, already recognized by him, be described. Inasmuch as Major Dunn has under preparation a treatise on his work in the Panama Canal Zone, records of the previously described species are not included in this contribution. I am greatly indebted to Major Dunn for the privilege of examining the interesting collection and also for permission to deposit the types in The American Museum of Natural History. Paratypes have been returned to Major Dunn.

NYCTERIBIIDAE

The collection contains two undescribed species of *Basilia* taken from the bat, *Myotis nigricans* Wiedemann. In 1916 Dr. G. F. Ferris illustrated two species of *Basilia* and in 1924 published a review of the known American Nycteribiidae in which seven species of *Basilia* were listed, three of them being too poorly described to be determined with any degree of certainty. From an examination of the descriptions and figures it seems certain that the two species described as new in the following pages can not possibly be the same as species described from South America, but there is a possibility that one of them may prove to be identical with the species described by Bigot as *Nycteribia mexicana*.

I have prepared a key to those females of *Basilia* that have been illustrated sufficiently well to permit of their positive identification, but I have made no attempt to key out the males. The terminology used is that of Ferris, but there appears to be some confusion in regard to the homology of the tergites. In my slide of *B. myotis* (♀) there appears to be a suture separating the first visible tergite near the base, but an examination of specimens in alcohol proves that this is not present. The impression that a suture is present is gained from the presence of a slightly concave area at the basal fifth of the tergite. It would probably be much better to designate the tergites as "first visible," etc., a course I have followed in the description of *B. dunni*.

***Basilia dunni*, new species**

Figures 1 and 2

A rather large species, the female slightly over 2 mm. in length. The abdomen shows distinctive characters, but the head, thorax, and appendages do not.

FEMALE.—First visible tergite convex and with stout bristly hairs on the disc, the apex with seven pairs of long bristles, the sides with six pairs of shorter ones. The large discal tergite bears scattered stout setulae except in the middle and in front; on the posterior border there are long bristles but the sides bear shorter ones posteriorly. The third visible tergite is divided from the fourth except in the middle, it bears two short bristles on either side, and the posterior border has three or four bristles on each side; fourth visible tergite with short setulae and two bristles on the sides. The sides of the abdomen, on the median third, bear short setulae and there are two long lateral bristles on each side. On the under side the first visible sternite is a little more than one-third as long as the abdomen; the following sternites, except the fifth visible, are separated from each other although the suture is less evident in the middle, and each bears a row of fine bristles on the posterior margin; third visible sternite with two rows of short setulae on the disc, the second with a row of longer ones posteriorly. The fifth and sixth sternites are united in the middle but with strong suture laterally.

HOLOTYPE.—Female, from *Myotis nigricans* Wiedemann, Santa Rosa, Panama, August 7, 1932 (L. H. Dunn), No. 498.

In some respects this species appears to approach *speiseri* Ribeiro, as originally figured, more closely than the figure given by Ferris, but the presence of bristles on the sides of the abdomen distinguishes it.

***Basilia myotis*, new species**

Figures 3 to 5

The head, thorax, and legs display no distinctive characters, these being found only upon the abdomen.

FEMALE.—First tergite not evident, the second moderately large, widest at the basal third, with distinct bristles on the sides and eight or nine pairs of long apical bristles extending to the tip of the third segment or beyond. Third tergite large, bare except near the lateral margins and on the sides and apex, the apical bristles interspersed with short spines; fourth tergite apparently represented by a pair of posteriorly converging lobes, each bearing several small bristles. On the sides of the abdomen beyond the middle are two transverse rows of four or five bristles, three of them visible from above. On the under side the sternite bearing the ctenidium is about half as long as the abdomen, the ctenidium projecting beyond the sides of the abdomen in most specimens; the following sternites are short and more or less shortened toward the middle where they are less clearly differentiated. The apical segment bears four discal bristles in addition to the marginal ones.

MALE.—This sex agrees rather closely with the male of *speiseri* Ribeiro, but it can apparently be distinguished by the coarser, more erect bristles on the terminal abdominal segment. On the dorsum these bristles are entirely erect, none being depressed.

Types.—Holotype, female, allotype, male, and paratypes, three males and three females, from *Myotis nigricans* Wiedemann, Tapia, Panama, December 21, 1933 (L. H. Dunn); six male paratypes from the same host species, Camoganti, Panama, January 31, 1933 (L. H. Dunn).

That this species differs markedly from *speiseri*, as figured by Ferris, is obvious by a comparison of the figures of the female. The male differs by having more numerous, erect bristles on the terminal tergite and they extend much closer to the base. From *silvae* Brethes it differs in the presence of long bristles on the sides of the tergites and, while Brethes' figure of the female is none too good, it is obvious that the two forms are different. It is possible that this form will prove to be *mexicana* Bigot, but this can only be determined by an examination of the type.

***Basilia speiseri* Ribeiro**

Pseudelytromyia speiseri RIBEIRO, 1907, Arch. Mus. Nac. Rio de Janeiro, XIV, p. 233 (f.).

Basilia speiseri FERRIS, 1924, Ent. News, XXXV, p. 198 (f.).

This species was originally described from both sexes from *Atalapha frantzii* Peters, both sexes being figured. If the figures given by Ribeiro are accurate, it seems certain that the species figured by Ferris is different. It should be particularly noted that the bristles on the first visible tergite in Ribeiro's figure extend little more than halfway to the tip of the second visible tergite and, in addition, the latter tergite bears half a dozen discal setulae on each side. Moreover, Ribeiro's figure of the under side of the female shows the sternite bearing the ctenidium to be much shorter than figured by Ferris. The specimens described by Ferris were from *Myotis nigricans* Wiedemann and were collected in Costa Rica.

***Basilia forcipata* Ferris**

FERRIS, 1924, Ent. News, XXXV, p. 196 (f.).

A very distinct species, apparently related to *dunni*, new species. Described from ten specimens from California, New Mexico, Louisiana, and Mexico, from the bats, *Myotis californicus quercinus*, *Myotis thysanoides*, and *Nyctinomus cynocephalus*.

***Basilia mexicana* Bigot**

Nycteribia mexicana BIGOT, 1885, Ann. Soc. Ent. France, p. 245.

Penicillidia mexicana SPEISER, 1902, Zeitschr. Hymen. u. Dipt., II, p. 171.

Basilia mexicana FERRIS, 1924, Ent. News, XXXV, p. 195.

The species is unrecognizable from the description.

***Basilis silvae* Brethes**

Cyclopodia silvae BRETHES, 1913, Bol. Mus. Nac. Chile, V, p. 297 (f.).

Judging from the illustrations this species is a true *Basilis*. The illustrations of the male are excellent, but that of the female is not sufficiently clear to permit determination.

STREBLIDAE

Major Dunn has submitted to me representatives of four new species belonging to the genera *Speiseria* and *Trichobius*, in addition to the recently described *Eldunnia breviceps*. The following key separates the American genera

KEY TO AMERICAN GENERA

- 1.—With a ctenidium of black bristles on the ventral surface of the head. 2.
Without a ctenidium on under surface of head. 5.
- 2.—Eyes present; wings well-developed, with six veins. 3.
Eyes absent; wings reduced to oval pads, much shorter than the thorax.
Metasemus Coquillett.
- 3.—Ctenidium extending to the sides of the head and visible laterally when seen from above. 4.
Ctenidium ending far before the sides of the head. *Eldunnia* Curran.
- 4.—Posterior femora about twice as long as the anterior ones; anterior cross-vein before the middle of the wing. *Strebla* Wiedemann.
Posterior femora decidedly less than twice as long as the anterior ones; anterior cross-vein beyond the middle of the wing. *Euctenodes* Waterhouse.
- 5.—Wings entirely lacking. 6.
Wings present, though small. 7.
- 6.—Posterior legs about twice as long as the anterior ones.
Megistopoda Macquart.
Posterior legs not twice as long as the anterior ones. *Paradyschiria* Speiser.
- 7.—Wings of normal size. 9.
Wings small, narrow or short. 8.
- 8.—Wings erect and narrow; posterior legs about twice as long as anterior ones.
Pterellipsis Coquillett.
Wings lying flat, short; posterior legs not twice as long as anterior ones.
Aspidoptera Coquillett.
9. Wings with six longitudinal veins. 10.
Wings with only three longitudinal veins and one cross-vein; thorax compressed.
Nycterophilis Ferris.
- 10.—Wings without cross-veins. *Kesellia* Curran.
Wings with at least two cross-veins. 11.
- 11.—Posterior legs extremely long, three times as long as the body. 12.
Posterior legs at most twice as long as the front pair. 13.
- 12.—Thorax much broader than long (Peru) *Synthesiostrebla* Townsend.
Thorax decidedly longer than wide. *Paratrachobius* Costa Lima.

- 13.—Posterior legs about twice as long as the anterior pair. *Speiseria* Kessel.
 Posterior legs obviously less than twice as long as the anterior pair. 14.
 14.—Head convex laterally and freely articulated. *Trichobius* Gervais.
 Head flattened and with lateral lobes that fit into excavations on the sides of the
 thorax. *Pseudostrebla* Costa Lima.

ELDUNNIA Curran

CURRAN, 1934, 'Fam. Gen. N. A. Dipt.', p. 479.

The specimens representing this genus came to hand as the above cited reference was in press and the genus included in order that the key to North American genera might be complete, but owing to the limited space it was not possible to include figures.

Eldunnia is most closely related to *Strebla* Wiedemann, but differs in having the combined mesonotum and scutellum only a little longer than wide and the head short and very broad. In addition, the ctenidium is composed of only eighteen spines and ends far before the sides of the head. The other characters are common to several genera in the family and need not be repeated here.

GENOTYPE.—*E. breviceps* Curran.

Eldunnia breviceps Curran

Figures 7 and 9

CURRAN, 1934, 'Fam. Gen. N. A. Dipt.', p. 479.

Length about 1.5 mm. Head slightly less than three times as wide as long (excluding the palpi), bearing a strong ctenidium below; eyes small, composed of five or six large facets; palpi large, subrectangular, their apices transverse, bearing some short apical bristles and coarse setulae, the lower surface clothed with coarse, short setulae.

Mesonotum almost evenly clothed with short, coarse hairs, the margin with short bristles; anterior border strongly excavated laterally for the reception of the lateral lobes of the head; median line extending about halfway to the suture; suture gently arched forward; prescutellar row of bristles very gently arched. Scutellum with two pairs of short bristles, the apical pair slightly longer than the lateral. Prosternum carried forward more strongly than the middle of the mesonotum, its anterior margin more evidently V-shaped; propleura lying almost horizontal and platelike in front of the anterior coxae. Halteres moderately large.

Legs and wings as figured.

Abdomen with relatively sparse setulae on the under surface, the upper surface wholly membranous and without hair except at the apex.

TYPES.—Holotype, female, and one paratype, from *Lonchophylla robusta* Miller, Chilibrillo Caves, Panama, March 9, 1933 (L. H. Dunn).

The specimens upon which the above description is based were forwarded by Major Dunn with the notation that they obviously represented an undescribed genus.

SPEISERIA Kessel

KESSEL, 1925, Jour. N. Y. Ent. Soc., XXXIII, p. 19.

The only species thus far placed in *Speiseria* is *ambigua* Kessel, originally described from *Carollia perspicillatum aztecum*, from Panama. I have seen specimens from Panama and British Guiana.

I am rather inclined to believe that *Speiseria* will eventually be found to be a synonym of *Paratrachobius* Costa Lima. I am not aware that any males have been found belonging to *Speiseria* and no females of *Paratrachobius* have been recorded. It seems remarkable that so many females of *Speiseria* should be found and so few males of *Paratrachobius*. The only specimen I have of this latter genus was taken along with four females of *Speiseria*, two of them belonging to *S. dunni*. The evidence supporting my argument is not, however, conclusive, and the two names may be retained until more material is available.

The two species placed in this genus may be readily separated by use of the following key.

TABLE OF SPECIES

- 1.—Median line of the mesonotum extending to the suture; eyes apparently with not more than nine facets. *ambigua* Kessel.
- Median mesonotal line extending only halfway to the suture; eyes with many facets *dunni*, n. sp.

***Speiseria dunni*, new species**

Figure 6

Agrees well with *ambigua* Kessel, but the number of eye-facets is apparently about twenty-one (I am unable to determine the exact number in the material before me), the bristles of the head are stronger, and the median line on the mesonotum extends only halfway to the suture. On the anterior of the mesonotum are three pairs of stout bristles, one on the humeri and two inside; apical scutellar bristles very much longer than the lateral pair.

The wings, legs, and abdomen do not show any striking differences.

Types. -- Holotype, female, and two paratypes, females, from either *Pteropteryx canina* Wiedemann or *Uroderma bilobatum* Peters, El Real, Panama, April, 1931 (H. C. Clark); two female paratypes, from *Uroderma bilobatum* Peters, Summit, Canal Zone, July 29, 1931 (L. H. Dunn).

PARATRACHOBIUS Costa Lima

COSTA LIMA, 1921, Arch. Esc. Sup. Agric. e Med. Veter., Nichtheroy, V, p. 20.

The type of this genus was originally described as *Trichobius longicrurus* by Ribeiro. If *Speiseria* should prove to be the same as *Paratrachobius* the genus would contain three species, unless *ambigua* Kessel is the female of *longicrurus*, a relationship that does not seem likely from

the figure given by Ribeiro. Both these species have the median line of the mesonotum entire.

I have before me a single male taken by Major Dunn at Summit, Canal Zone, July 29, 1931, in company with two females of *S. dunnii*, and I believe it to be the male of that species. For this reason I am not naming it. The chaetotaxy of the head and thorax is the same except that the bristles are longer and stouter, especially those on the back of the head and front of the thorax, and the median scutellar bristles are very long. The front femur bears the obliquely transverse row of stout spines above, such as occur in *longicrurus*.

TRICHOBIUS Gervais

A key to the known species belonging to this genus is presented. It should be borne in mind that a magnification of at least fifty is necessary in order that all details may be observed and that proper lighting is essential if the tiny setulae on the mesonotum are to be seen. Under improper lighting and low magnification the disc of the mesonotum may appear to be bare.

TABLE OF SPECIES

- 1.—The median line of the mesonotum extends to the suture 2.
The median line does not nearly reach the suture, usually extending less than halfway..... 6.
- 2.—Femora with some coarse bristles..... 3.
Femora rather densely hairy, none of the hairs stout. *hirsutulus* Bequaert.
- 3.—Transverse mesonotal suture marked by a black line; length about 4 mm. 4.
Transverse suture not marked by a black line..... 5.
- 4.—Eight scutellar bristles..... *major* Coquillett.
Four scutellar bristles *quadrisetosus* Kessel.
- 5.—Small species, about 1.25 mm. long (Fig. 8)..... *uniformis*, n. sp.
Large, about 4 mm. long..... *corynorhini* Cockerell.
- 6.—Mesonotum with a large part of its surface without apparent hairs, the minute ones absent. 11.
Mesonotum with at least minute hairs over the middle 7.
- 7.—Mesonotum very strongly rounded in front, almost hemicircular before the suture..... *caecus* Edwards.
Mesonotum much less obviously rounded, the humeral angles more or less evident..... 8.
- 8.—Median bristles on the front of the mesonotum not much weaker than those toward the sides..... 9.
Median mesonotal bristles all very much weaker than those toward the sides (Fig. 10)..... *mixtus*, n. sp.
- 9.—Mesonotum practically transverse in front..... 10.
Mesonotum rather evidently rounded in front..... *phyllostomae* Kessel.

- 10.—With a row of distinct bristles in front of the scutellum.....*dugesii* Townsend.
 With only short setulae in front of the scutellum (Fig. 11).....*blandus*, n. sp.
- 11.—With a row of bristles preceded by a row of setulae in front of the scutellum.
sparvus Kessel.
 With only short setulae in front of the scutellum..... 12.
- 12.—Several rows of short setulae immediately in front of the scutellum; suture separating scutellum and mesonotum complete.....*truncatus* Kessel.
 A single row of setulae in front of the scutellum (Fig. 12)...*parasiticus* Gervais.

Trichobius corynorhini Cockerell

COCKERELL, 1910, Can. Ent., XLII, p. 59.

? *Trichobius major quadrisetosus* KESSEL, 1925, Jour. N. Y. Ent. Soc., XXXIII, p. 15.

Despite the presence of a ferruginous line on the transverse suture, I am referring fifteen specimens from a "lump-nosed bat" to this species; they were collected six miles southwest of Freedom, Woodward County, Oklahoma, on July 17, 1930, by Dr. R. D. Bird. Some of the specimens agree perfectly with Dr. Cockerell's description, disagreeing only in the presence of the dark sutural line. Other specimens differ only in the number of facets in the eyes.

The number of eye-facets is not an important character unless it differs greatly. In the series before me I find the following variation.

Two females with 11 ommatidia
 Two males and five females with 13 ommatidia
 Five males and one female with 14 ommatidia
 One male and one female with 15 ommatidia

In addition, one of seven specimens of *T. major* Coquillett has nine ommatidia, the remainder with the normal eight.

If I am correct in the suggested synonymy, the difference between this species and *major* is not confined to the number of scutellar bristles and position of the cross-veins. The aristaе are very different. In *major* the arista has the rays all on one side and they are longer than in *corynorhini*. In *corynorhini* the rays are shorter, situated on the anterior side, except near the apex where they arise from the inner side and give a peculiar brushlike termination to the organ. This difference is of importance and the character tends to verify the distinctness of the two species.

Only a comparison of the types of *quadrisetosus* and *corynorhini* will clear up the identity of the forms.

Trichobius uniformis, new species

Figure 8

A small species, only about 1.25 mm. in length, the mesonotum with almost uniform bristles.

Head pyramidal; eyes small; palpi sparsely bristled on the under surface. Mesonotum and scutellum longer than wide, the suture separating them entire although very weak except toward the sides; median mesonotal line extending to the suture, the suture curved forward medianly; scutellum with four bristles. Legs robust; femora with bristles. Wings with venation and chaetotaxy as figured. Abdomen with numerous tiny setulae beneath.

Types.—Holotype, female, allotype, male, from *Glossophaga soricina leachi* Gray, Paraiso, Canal Zone, October 17, 1930 (No. 31). Paratypes: male and female, from *Lonchophylla robusta* Miller, Chilibrillo Caves, Panama, March 9, 1933 (No. 16); male and two females, from *Glossophaga soricina leachi* Gray, Bella Vista, near Panama City, June 25, 1931 (Nos. 33 and 34). All the specimens were collected by Major L. H. Dunn.

Trichobius mixtus, new species

Figure 10

A moderately large species (length about 2 mm.), very similar to *dugesii* Townsend, but without strong bristles on the middle of the mesonotum in front.

Palpi rather convex on the inner edge, bearing a long bristle on the outer apex and with two shorter bristles in front; bristles of the head rather long; propleura prominent, with three bristles on the outer edge; mesonotum and scutellum longer than wide, the transverse suture bowed back, the disc evenly setulose, in front with very short bristles, the sides with longer ones. Femora robust, bearing bristles. First and third veins each with one strong basal bristle, the fourth with three. Abdomen with strong bristles on the sides basally and at the apex.

Types.—Holotype, male, and six paratypes, males, from *Phyllostomus hastatus panamensis* Allen, Chilibrillo Caves, Panama, August 4, 1931 (L. H. Dunn).

Trichobius blandus, new species

Figure 11

A small species (1.25 to 1.5 mm. long), related to *parasiticus* Gervais, but with the mesonotum much more extensively bristled.

Head with rather few bristles; palpi convex inwardly, the outer apex with a long fine bristle, the apex with two short bristles, the under side sparsely setulose. Thorax almost transverse in front; mesonotum and scutellum about as long as wide, the mesonotum with tiny setulae and bristles as shown in the figure, the setulae before the scutellum only a little stronger than those on the disc, prothorax rather truncate and with bristles in front. First vein with a very long basal bristle, the fourth and fifth each with two weaker ones. Legs with bristles. Abdomen with bristles apically and on the sides basally, the sides with numerous tiny setulae, the disc bare.

Types.—Holotype, male, allotype, female, and paratypes, two females, from *Glossophaga soricina leachi* Gray, Paraiso, Canal Zone, October 17, 1930 (No. 7);

eight females from the same host, Bella Vista, near Panama City, June 25, 1931 (Nos. 32, 33), all collected by L. H. Dunn.

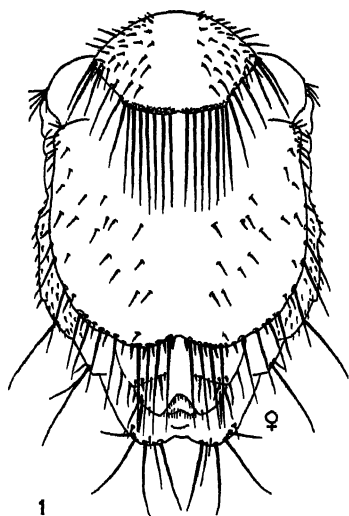
The arista is whitish, thick basally, the rays all arising from the anterior surface, long toward the base and gradually shortening toward the apex.

***Trichobius parasiticus* Gervais**

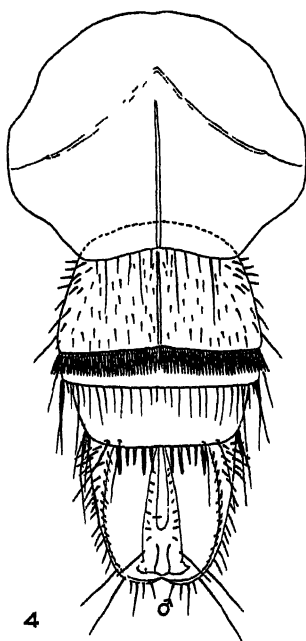
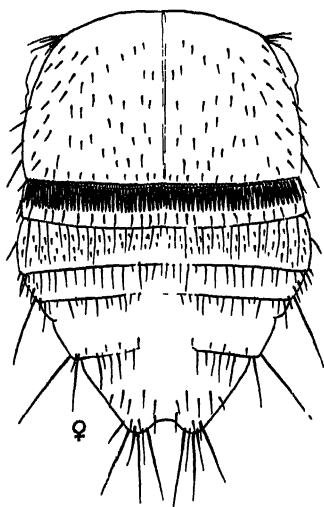
Figure 12

GERVAIS, 1844, 'Atlas de Zoologie,' Paris.

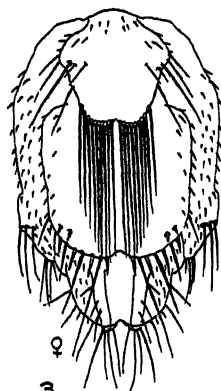
Unfortunately I do not have access to the original description of this species so can give no page reference. I have followed Kessel in the determination of the species but feel that there must be a great deal of doubt concerning the identity of the form described by Gervais. Unless the type is in existence the current interpretation of the species should be accepted.



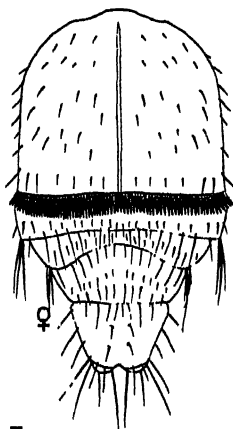
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4



3



5

- Fig. 1. *Basilina dunni*, new species, female abdomen from above.
 Fig. 2. *Basilina dunni*, new species, female abdomen from below.
 Fig. 3. *Basilina myotis*, new species, female abdomen from above.
 Fig. 4. *Basilina myotis*, new species, male thorax and abdomen from below.
 Fig. 5. *Basilina myotis*, new species, female abdomen from below.

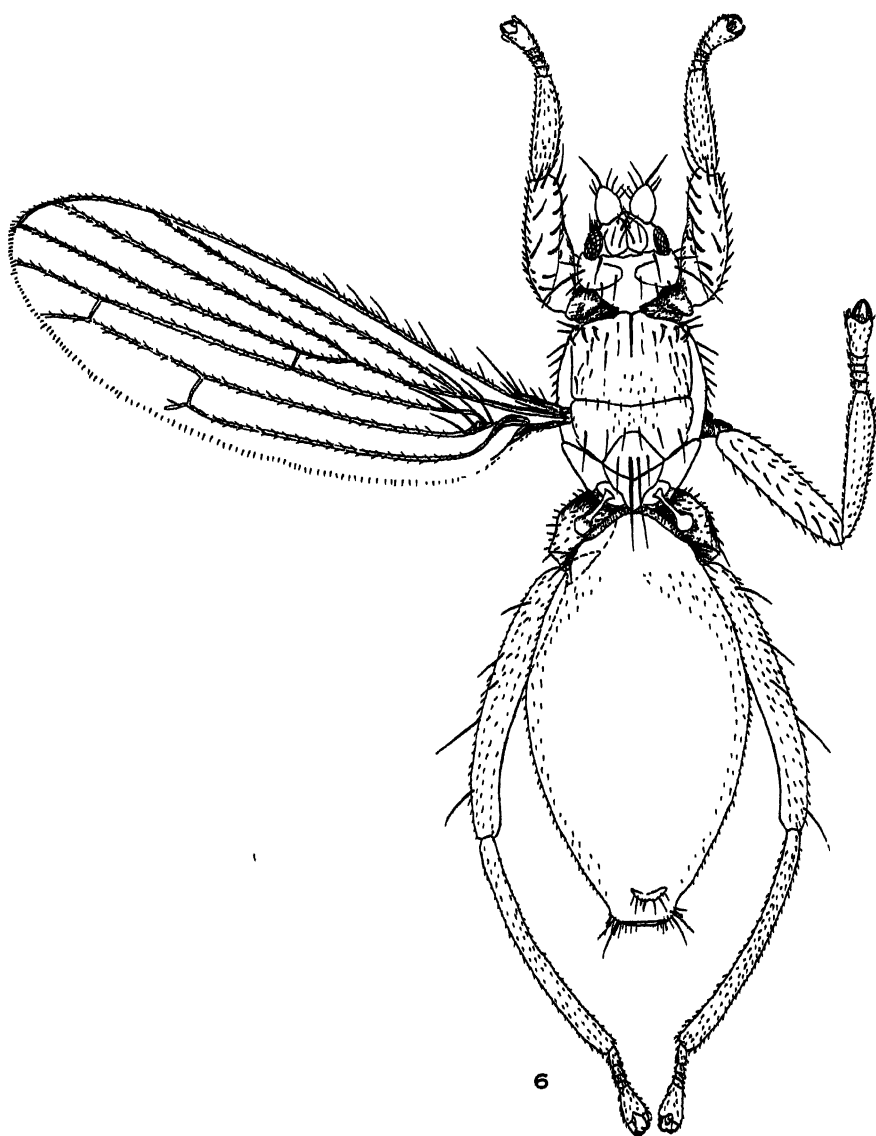


Fig. 6. *Speiseria dunni*, new species, female.

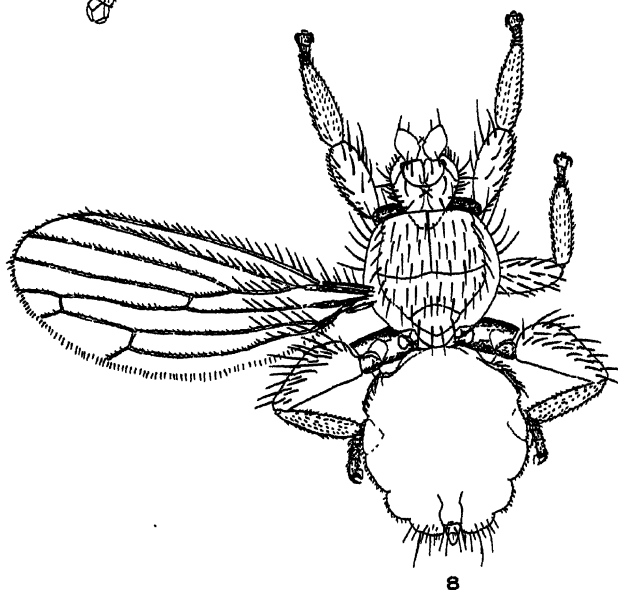
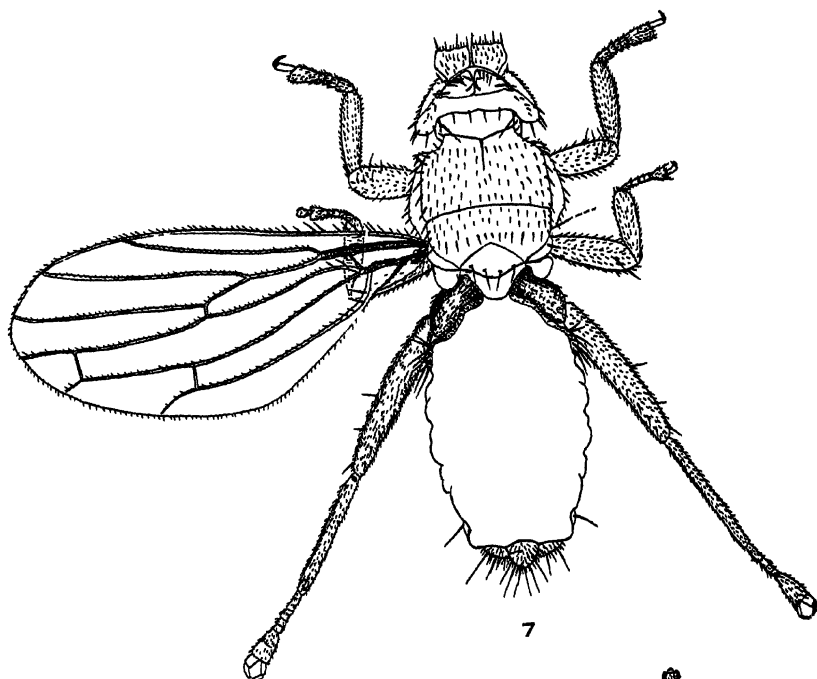


Fig. 7. *Eldunnia breviceps* Curran, female.
 Fig. 8. *Trichobius uniformis*, new species, female.

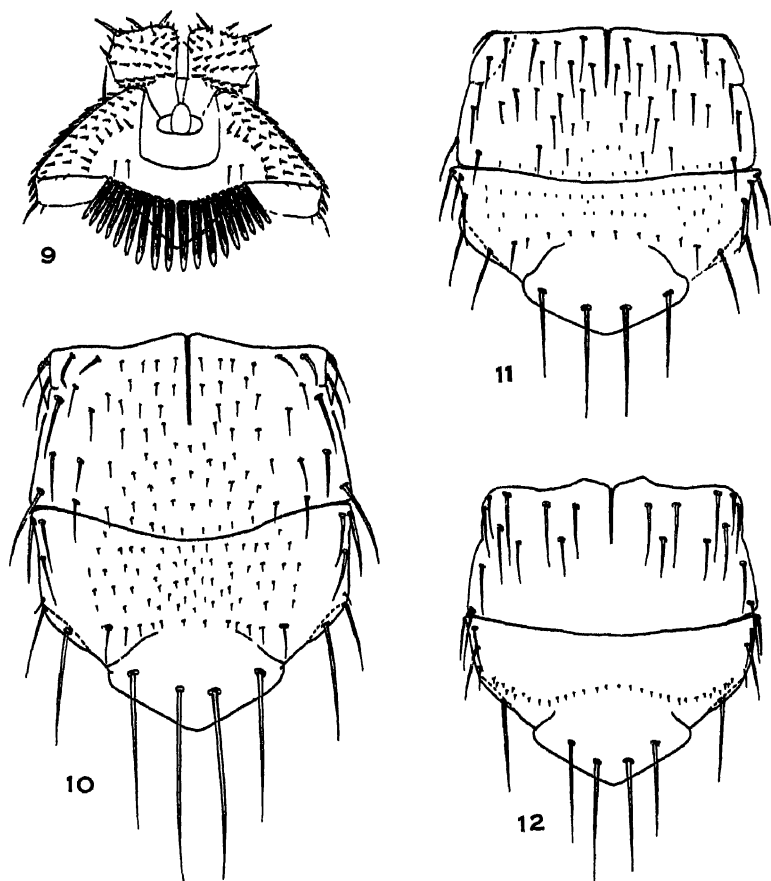


Fig. 9. *Eldunna breviceps* Curran, female head from below.
 Fig. 10. *Trichobius mixtus*, new species, mesonotum.
 Fig. 11. *Trichobius blandus*, new species, mesonotum.
 Fig. 12. *Trichobius parasiticus* Gervais, mesonotum.

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NEW RECORDS OF BEES

By T. D. A. COCKERELL

This paper is based on material that will be found in The American Museum of Natural History.

BEES AT FLOWERS OF *Gilia calcaria* JONES

At the Ten Sleep Ranch, near Elbert, Colorado, altitude about 6700 feet, on June 3, 1934, Mr. J. D. Figgins collected a series of bees at flowers of *Gilia calcaria*. Although the flowers are inconspicuous, they are very attractive to bees, as the following list shows.

Halictus trizonatus Cresson. 7 females. All have the bands of abdomen white, instead of fulvescent, as is usual in the species. The recently described *H. athabascensis* Sandhouse is closely allied, but is easily separated by the shorter, more coarsely sculptured area of metathorax in the female. [Paratype from Kaslo, B. C. (Dyar) compared.]

Agapostemon virens (Fabricius). Two females.

Monumetha albifrons (Kirby). Two males.

Anthidium dentipygum (Swenk). One female.

Anthidium astragali Swenk. One male. All the tibiae have a broad yellow stripe on outer side, but in another male, taken at the same time and place, the stripe on hind tibiae is reduced to a mark at either end. The thorax above has ferruginous hair, and the tegulae have a large black spot surrounded by yellow.

Anthidium tenuiflorae Cockerell. One male. A variety with hair on head and thorax above bright ferruginous. It is readily known from *A. astragali* by the black scape with a yellow apical spot, the tegulae yellow in front and black behind (the yellow not enclosing a spot), and the tibiae black on outer side, with a small pale basal mark.

Megachile wootoni calogaster Cockerell. Two males.

Megachile montivaga Cresson. One male.

Megachile onobrychidis Cockerell. Three males. Some years ago I concluded that *M. onobrychidis* might be considered a race or variety of *M. perbrevis* Cresson. Professor T. B. Mitchell now informs me that he has examined the type of *M. perbrevis* and finds it identical with *M. brevis*. He is recognizing *onobrychidis* as a western variety of *M. brevis*.

Say, and has seen it from California, British Columbia, and east as far as Nebraska, Colorado, and Texas.

Coelioxys ribis Cockerell. Two males.

Alcidamea producta Cresson. One female.

Osmia bruneri Cockerell. One female.

Osmia giliarum Cockerell

FEMALE.—Length, 8 mm.; robust, head ordinary, with normal clypeus; head and thorax glaucous green, densely punctured, the vertex, and mesothorax on disc, shining between punctures, the punctures of vertex coarser than those of mesothorax; hair of head and thorax dorsally white, without any black intermixed, of pleura entirely black, but white at sides of metathorax; face with long coarse black hair, but mixed with white on upper part, or practically all black; no orange hair below clypeus; face broad; mandibles tridentate; clypeus and sides of face dark blue, densely punctured, apical margin of clypeus shining; antennae black, or the flagellum very faintly reddish beneath; a groove, but no smooth band, down front; area of metathorax dull, bluish, shining at sides posteriorly, contrasting with the green postscutellum; tegulae shining green anteriorly, but the posterior half black; wings strongly brownish, but with no marked cloud in marginal cell; basal nervure meeting nervulus; second cubital cell long, receiving first recurrent nervure far from base, the second somewhat nearer apex; second cubital a little broader on marginal than first; legs entirely black, with black hair, dense and seal brown on inner side of front tarsi; spurs black; abdomen short and broad, shining, with entirely black ventral scopa; above, the hair is white on first tergite, on second white, but thin and short, only noticeable in side view, on the others black, but short; smooth margins of tergites broad, steel blue; second tergite finely punctured, but conspicuously shining.

Five females, three from *Gilia*. In my table (1928) this runs to 71, differing from *O. hypoleuca* by the wholly black hair of pleura. Carried beyond, it goes to *O. grindeliae*, which differs by the dull second tergite and rather narrow abdomen. In the Sandhouse tables to Californian and Canadian species it also runs to the vicinity of *O. grindeliae*, differing by the green mesothorax, and basal nervure meeting nervulus. The shining second tergite is the best character, and is very distinctive.

Osmia figginsi, new species

MALE.—Length about or slightly over 8 mm.; head and thorax yellowish green, with very abundant long wholly white hair, shining silvery on face; face narrow; eyes gray; mandibles bidentate; vertex densely punctured and dull; antennae long, entirely black, simple; mesothorax densely punctured, shining between the close punctures on posterior disc; area and posterior face of metathorax dull, bluish green; tegulae green, black on outer side; wings hyaline, not evidently brownish; basal nervure meeting nervulus; second cubital cell receiving recurrent nervures far from base and apex, the distances about equal; legs strongly metallic, but the front femora and tibiae shining black in front; hair of legs white, brownish on inner side of tarsi;

last joint of hind tarsi dusky red; middle tarsi simple; hind basitarsi slender, not toothed; abdomen shining, mostly steel blue, but greener toward base, and the first tergite yellowish green; smooth margins of tergites rather narrow; first tergite with long white hair, the others with scanty short white hair; sixth tergite with a small but deep notch, seventh bidentate; venter simple. One male. In my key (1928) this falls with *O. pulsatillae* Cockerell, which has dark hairs intermixed on thorax above. It is also very like *O. wheeleri* Cockerell, but readily separated by the clear green color of the legs and the much smaller and narrower apical bidentate process of abdomen. The mesonotum posteriorly is very densely punctured, not shining as in *O. wheeleri*.

In the Sandhouse table of Californian species it runs out at 15, having the sixth tergite notched and the hind basitarsi simple. In the Sandhouse table of Canadian species it runs out next to *O. coerulescens* (Linnaeus), but the pubescence is not fulvous.

A *Melissodes* NEW TO COLORADO

Melissodes bimaculata Lepelletier

At Boulder, in the immediate vicinity of the University, on July 27, 1934, Mr. Maurice James collected a female *M. bimaculata*. This species is so conspicuous and easily recognized that it is hard to believe that it has been a member of our fauna during the past years of collecting. We know little or nothing concerning the migrations of bees, but as the records become more complete and accurate it may well be that evidence concerning such movements will be forthcoming.

Osmia FROM CALIFORNIA

Osmia regulina Cockerell

FEMALE. —Herkey Creek, California, June 24, 1934 (Cockerell). It was at flowers of *Lupinus*. I submitted the plant to Miss Alice Eastwood, who writes: "It is one of the many varieties of *L. bicolor* Lindley; it may be *L. bicolor microphyllus*, which in Southern California is erroneously called *L. micranthus*." In the table of California *Osmia* by Miss Sandhouse this does not run well, because she says "femora obscurely metallic." They are strongly metallic.

Osmia celsa Sandhouse

FEMALE. —Mountain Home Creek, San Bernardino Mts., California, June 17, 1934, at flowers of *Dicentra chrysantha* (Cockerell). Big Pines, California, at flowers of *Phacelia heterophylla*, July 2 (Cockerell). The amount of white hair varies, but it is entirely black on the face. The species is extremely close to *O. pogonigera* Cockerell, but the face appears more shining.

***Osmia pinorum*, new species**

Female.—Length about 7.3 mm., anterior wing 6.2; robust, with very broad abdomen; head and thorax dark bluish green, steel blue at sides of face; hair, including ventral scopa, mainly black, long and black on face, thin, with white and black mixed, on front and vertex, entirely clear white on dorsum of thorax, white on tubercles, white on metathorax except at extreme sides; abdomen with long white hair on first tergite; first three tergites with very thin bands of rather long white hairs; hair of legs mainly black, but light on front tarsi; antennae black, the flagellum very obscurely reddish beneath; tegulae with the anterior half green; wings brownish hyaline, basal nervure meeting nervulus; second cubital cell very long, receiving first recurrent nervure far from base, and second much nearer apex; hind basitarsi very stout. Clypeus normal, strongly convex, very densely punctured, in middle blackish, turning to yellowish green above, at sides bluish; front dull, very densely punctured; vertex behind ocelli yellowish green, glistening between the dense punctures; mesothorax dull, extremely finely and densely punctured, scutellum moderately shining in middle; area of metathorax bluish green, the basal part dull, the apical part shining; abdomen highly polished, greenish, with the depressed apical margins of tergites broad, minutely sculptured, more bluish. Mandibles very broad, strongly tridentate. Big Pines, California, July 2 (Cockerell).

In my table, and the table of Californian species by Miss Sandhouse, this runs exactly to *O. grindeliae* Cockerell, from which it differs at once by the polished second tergite. Herein it more approaches *O. giliarum* Cockerell, differing by the white hair bands on abdomen.

O. pinorum is in most respects very like *O. liogastra* Cockerell, from which it is easily distinguished by the long coarse black hair on face, and the much stouter hind basitarsi.

BEES AT FLOWERS OF *Convolvulus hermannioides* A. GRAY

Mr. H. B. Parks sends a series of small bees collected in the vicinity of San Antonio, Texas, at flowers of *Convolvulus hermannioides*.

Ancylosceles maculifera Cockerell. 13 males, 3 females. The males all differ from the holotype in having the labrum entirely black, but otherwise they agree. The female is new. In my key 1923, Proc. Calif. Acad. Sci., XII, p. 84, it runs as follows:

- 1.—Antennae black, the flagellum obscurely reddish beneath. . . *melanostoma* Cockerell.
Flagellum distinctly red beneath. 2.
- 2.—Scape black; red of flagellum dusky; clypeus shining, very finely striate and punctured. *maculifera* Cockerell.
Scape red; red of flagellum very bright; clypeus much more coarsely sculptured. 3.
- 3.—Ocelli red; clypeus dull. *globulifera* (Cockerell).
Ocelli white; clypeus glistening. *armata* Smith.

The female might be thought a form of *A. melanostoma*, but the male shows that it is distinct. Mr. Parks writes:

"*Convolvulus hermannioides* is a small morning-glory having a white flower about an inch in diameter. When the flower opens it is pure white; after pollination occurs, the tube and centre of the disc turn blood red. I have found *A. maculifera* on this morning-glory wherever I have found the plant, and on no other flower."

Exomalopsis (Anthophorula) compactula (Cockerell).—Numerous specimens of both sexes. The male has the clypeus, supraclypeal mark, labrum, and greater part of mandibles light yellow. The flagellum is thick, light orange-ferruginous, each joint with a raised black mark above, and the last joint broadly black above at end. The scape is mainly black, or extensively marked with yellow. (The male of *E. coquilletti* Ashmead has a much longer, slender, quite different flagellum.)

This species exists in two forms:

(a). *E. compactula*, typical form.—Anterior wings with only two cubital cells, the second intercubitus lacking; apex of wing with a distinct dusky cloud; scape of male with a large yellow spot on apical half, and usually a line extending from this toward the base. Type from Mesilla Valley, New Mexico. Both sexes, with red tegulae, from Brownsville, Texas (Snow). Four of each sex taken by Mr. Parks at *Convolvulus*.

(b). Variety **completa**, new variety.—Anterior wings with three cubital cells, the first recurrent nervure joining apical corner of second cubital; no distinct cloud at apex; scape of male black, with at most a rather obscure pale mark near apex. Organ Mountains, New Mexico. Four females and three males taken by Mr. Parks at *Convolvulus*. The type of the variety is a male from near San Antonio.

The two forms appear to have the same distribution and, notwithstanding the differences, seem to belong to a single species.

The remaining species are represented by only one to three specimens each, and probably have no special connection with the *Convolvulus*.

Exomalopsis (Anthophorula) morgani Cockerell.—Two males, one female. This species was described from the female, taken at Falfurrias, but the males before me evidently belong to it. The supraclypeal area is shining black; the clypeus and labrum are lemon yellow; mandibles black basally, with the apical half obscurely reddish. Scape black; flagellum dull red beneath except at base. The antennae are simple and only moderately long; they differ little from those of the female. This male is near to *E. bruneri* Crawford, but rather smaller, and the abdomen not shaggy with long hairs, the wings grayish and the stigma dusky.

Melissodes agilis Cresson, variety **parksii**, new variety.—A very small male, with very long antennae, the flagellum light ferruginous

below, dusky reddish above; eyes very dark brown; clypeus, labrum, and large mark on mandibles pale lemon yellow; hair of head and thorax abundant, entirely white; wings slightly milky, but nervures dark; second cubital cell broad, parallel-sided, receiving recurrent nervure a little beyond the middle; tergites with hyaline margins, and dense slightly ochreous hair-bands; subapical lateral teeth triangular. The anterior wings are 5 mm. long, the flagellum of antenna 7 mm.; third antennal joint short, but longer than second; knees, tibiae at end, and tarsi except basally, red.

Taken May 17. It is very possibly a distinct species, and if not, it could about as well be regarded as a race of *M. pimella* Cockerell, 1906, described from Arizona.

***Nomada pasitura*, new species**

FEMALE.—Length about 5.7 mm., anterior wing 4.4; head and thorax shining black, without yellow markings, but lower margin of clypeus, labrum, and mandibles dark red, and tubercles red; face, sides of front, and cheeks posteriorly, with silvery-white hair; head very broad, facial quadrangle broader than long; upper part of clypeus dull and finely punctured, lower part polished; mandibles simple; third antennal joint short, but longer than second or fourth; scape black, with a red spot at end; flagellum thick, not very long, black; eyes dark slate-color; mesothorax and scutellum shining, but well punctured; pleura crossed by a very broad band of dense silvery hair; white hair at each side of upper border of prothorax, at anterior corners of scutellum (which is swollen but not at all bigibbous), forming a transverse band at each side of lower part of scutellum, on postscutellum, and on posterior face of metathorax except in middle; metathorax behind with a median groove; tegulae bright apricot-color; wings hyaline, with a dusky cloud in end of marginal cell, and a dusky spot at apex of wing; stigma rather small, reddish, nervures fuscous; basal nervure meeting nervulus; second and third cubital cells subequal, higher than broad, receiving recurrent nervures some distance from end; legs bright ferruginous, with white hair, all the tibiae with a blackish patch on outer side; hind femora and tibiae stout; spurs black; abdomen shining, bright ferruginous, the apical portion suffusedly blackish; some white hair at sides of first tergite, a large pure white patch at each side of second, the others with broadly interrupted white bands; apical plate broad, truncate, entire, covered with fine silvery hair; venter red, in lateral view showing silver-white hair.

One male, taken May 20, 1934. I suspect that it is a parasite of *Exomalopsis compactula*. It is a remarkable species, the abdomen resembling that of *Pasites*. In general appearance, it suggests *N. grindeliae* Cockerell and *N. heleniella* Cockerell, but these have the abdomen red only in the female.

AN EPEOLINE SUPPOSED TO BE PARASITIC ON *Nomia**Trypoxylon bardus* (Cresson)

Mr. H. B. Parks sends a series of 8 ♀ and 2 ♂ *Trypoxylon*, with a note that they were taken under circumstances strongly suggesting that they may be parasitic on *Nomia*. They were at flowers of *Ximenesia encelioides* (presumably the form *exauriculata*), Wilson County, Texas, Oct. 22, 1934. One male is *T. concavus* (Cresson), but all the others are *T. bardus* (Cresson), which apparently must be local in Texas, as Brues (Entom. News, 1903, p. 82) did not find it. The females average somewhat larger than the type and show color variations as follows:

(a). Scutellum and axillae red, as also are labrum, mandibles, two large marks on apex of clypeus, scape and two following antennal joints, tubercles, anterior corners of mesothorax, large transverse mark on mesopleura, pygidial plate, and legs.

(b). Scutellum with two red spots, axillar spines red; mark on pleura and red at corners of mesothorax reduced.

(c). Scutellum, axillae, and mesothorax all black; no red mark on pleura.

The legs also vary, often having much black on the femora.

The male is similar to the female; scutellum, axillae, mesothorax, and pleura all black; scape black, a little red at each end, but third antennal joint with a large bright red area in front.

In all, the wings are dark fuliginous.

The species is related to *T. simplex* Robertson, but quite distinct.

A BEE VISITING FLOWERS OF *Parosela nana* (TORREY)

This species was collected near San Antonio, Texas, by Mr. H. B. Parks, who writes that he has found only the pair described.

Xenoglossodes habrocoma, new species

MALE (type).—Length about 9 mm.; black, with the small joints of tarsi red; clypeus black, with a broad yellow apical band; labrum and large spot on mandibles also very pale yellow; antennae very long, reaching to third abdominal tergite, black, the flagellum faintly brownish beneath; scape shining, extremely short; third antennal joint short; facial quadrangle about square; eyes green; clypeus, labrum, and lower part of cheeks with pure white hair; that on upper part of face and on front somewhat grayish; head and thorax above with long white hair, and no dark intermixed; mesothorax shining, finely punctured, scutellum dullish, more closely punctured; tegulae light brown; wings hyaline, with dark nervures; basal nervure falling far short of nervulus; second cubital cell broad, receiving recurrent nervure a little beyond middle; legs with white hair, pale ferruginous on inner side of tarsi and of front tibiae; abdomen dullish, closely punctured, the margins of the tergites brown; the abdomen is thinly covered with very short white hair, and the margins of second and following tergites have rather weak bands.

FEMALE.—Length about 9.5 mm.; more robust, with short antennae, the flagellum dusky red beneath except at base; eyes blue-green; facial quadrangle broader

than long; clypeus and labrum black, but the latter appearing light because densely covered with pale hair; mandibles dark reddish, black at apex; hair of head and thorax above conspicuously stained with brown; front and middle tibiae with reddish hair at apex; abdomen broad, thinly covered with fine white tomentum, the middle of fifth and sixth tergites with dark chocolate; venter with short red hair, bright at apex.

One of each sex, taken May 20, 1934. The female resembles *X. albata* (Cresson), from which it is best distinguished by the dark hair at end of abdomen. The male differs at once from *X. albata* by the face markings. It may be worth while to note that *Dianthidium profugum* Cockerell, 1923, said to be from "*Dahlia spinosa*," was really from *Parosela* (or *Dalea*) *spinosa*.

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A NEW *COLIAS* FROM SOUTH DAKOTA (LEPIDOPTERA: PIERIDAE)

BY ALEXANDER B. KLOTS¹

Some time ago Mr. Emil Krauth of Hebron, North Dakota, while collecting in the Black Hills of South Dakota, took an excellent series of a very distinct, undescribed subspecies of *Colias christina* Edwards. Knowing that I was engaged in a study of the butterflies of this genus, Mr. Krauth very kindly gave me his entire series of the form. It seems advisable to name it without further delay, as my revision of the genus will probably not be completed for some years to come.

Colias christina krauthii, new subspecies

This is a geographic race of *Colias christina* Edwards, apparently endemic to the Black Hills of South Dakota, which differs from the typical subspecies *christina* in the following particulars:

MALE.—Wings above: ground color darker, deeper orange; black discocellular spot of primaries always well developed and distinct, averaging slightly larger; orange discal spot of secondaries slightly less prominent. Wings beneath: ground color of costa, apex, and outer margin of primaries, and entire area of secondaries, decidedly grayish green (in typical *christina* these areas, with the occasional exception of the anal angle of the primaries, are definitely orange or orange yellow); discal area of primaries more consistently dusted with black or fuscous scales; discal spot of secondaries much less prominent due to the fact that its encircling ring is of a very light, washed-out pink (in typical *christina* this is of a much darker pinkish-brown or reddish brown, and is often much wider); entire area of secondaries on the average more heavily dusted with fuscous scales.

FEMALE. - Wings above: ground color lighter than in males but definitely orange in all specimens seen (in *christina* a large proportion of the females are yellow or white); dark borders consistently present, wider than in *christina*, with the included light spots yellow or orange yellow (in one specimen only they are orange as in the ground color); discocellular spot of primaries averaging larger and more conspicuous. Wings beneath: differences as in males, but even more conspicuous; in some specimens the areas described as "grayish green" in the males are of a peculiar grayish white with a faint greenish-yellow tint, totally different from anything I have ever seen in typical *christina*.

Types.—Male holotype, allotype, and thirty-one male and seven female paratypes, from twelve miles west of Custer, Black Hills, South Dakota, June 29, 1933; four male paratypes, vicinity of Custer, South Dakota, June 27, 1933, and five male

¹A contribution from the Department of Biology of the College of the City of New York.

and six female paratypes, Black Hills, South Dakota, July 1, 1931, all collected by Emil Krauth.

Holotype, allotype, and twelve male and five female paratypes are in The American Museum of Natural History; the remainder are in the author's collection.

C. c. krauthii has been compared with a large series of *christina* from southern and central Manitoba, Saskatchewan and Alberta. The only specimens with which it might possibly be confused are a few from a series from Laggan and End Mt. near Exshaw, Alberta, which, because of the possession of considerable greenish-fuscous suffusion on the secondaries beneath, likewise differ from the typical form of *christina*.

No yellow forms such as *astraea* and *emilia* were in this material; it is probable that they do not occur in the Black Hills.

59 7, 56 H

TWO PARTIALLY AMBICOLORATE FLATFISHES
(HETEROSOMATA)I.—A SUMMER FLOUNDER, *PARALICHTHYS DENTATUS*II.—A RUSTY DAB, *LIMANDA FERRUGINEA*

BY E. W. GUDGER

INTRODUCTION

For these two abnormally colored flatfishes,¹ as well as for many other teratological fishes, the Department of Ichthyology of the American Museum is indebted to the courtesy of Mr. F. E. Firth of the U. S. Bureau of Fisheries. Stationed for duty at the Boston Fish Pier, Mr. Firth has made valuable contacts with a large circle of fishermen and has interested them in the preservation of all kinds of freak and unusual fishes. A large part of our collection of teratological fishes has come to us through this friendly coöperation.

Definite accounts of partial ambicoloration in American flatfishes are very few. In a previous paper (Gudger, 1934) I have listed these, and it is unnecessary to report these titles here. In that article I described ambicoloration in two winter flounders, *Pseudopleuronectes americanus*. One was partially ambicolorate without other deformity, the other nearly completely dark below with the rotating eye just over the dorsal crest, and with a hooked dorsal fin. Those fishes and the ones before me now have started me in extensive studies of those anomalies to which the flatfishes (Heterosomata) are peculiarly liable.

Flatfishes are teleosts which have become compressed in a right-left or lateral plane, and have come to lie on one side (the right in the summer flounder, the left in the rusty dab) which is white and blind, whereas the upper side is colored and has two eyes. Such is a normal flatfish, a teratological fish, but one which is entirely normal in its group. When a flatfish, instead of being white below, has any areas of dark color on the under side, such a specimen is called ambicolorate—with like color on both sides. More strictly a partially ambicolorate fish has a considerable area (generally solid) of dark color extending forward in varying distance from the caudal fin.

¹These specimens were kindly identified by my colleague, Mr. J. T. Nichols.

I.—A PARTIALLY AMBICOLORATE SUMMER FLOUNDER

Paralichthys dentatus

The specimen before me is 19.5 in. over all and 5 in. deep (body only), and weighs 13 oz. Since the average weight of flounders of this species is 3 pounds, this must be a young fish. Furthermore, fish weighing 7 to 10 pounds are not rare, and a maximum of 30 pounds and 3 feet is sometimes reached. The summer flounder is an important food fish from Massachusetts to at least as far south as Cape Hatteras.

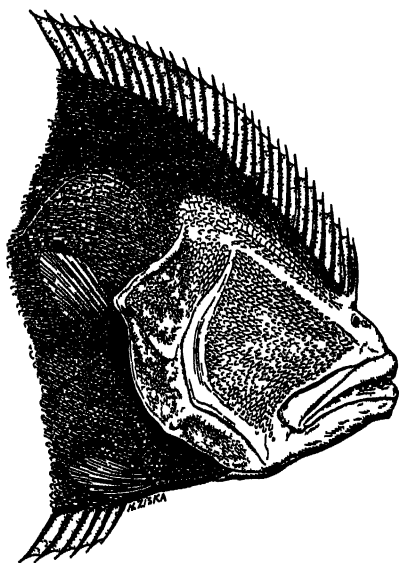


Fig. 1. Lower side of head region of a partially ambicolorate left-pointing *Paralichthys dentatus*. The whole lower side is colored like the upper, save the head as shown. The color in the opercular region is not on the outside but in the tissue lining the transparent gill covers. $\times \frac{1}{2}$

The present specimen was taken in a trawlnet in water about 50 fathoms deep, southeast of Cape Henry, Virginia, by Capt. Frank Favaloro of the fishing schooner "Grace F." of Gloucester, Massachusetts, during February, 1934. He was careful to preserve and transmit it to Mr. Firth, and the American Museum profits by his interest.

The upper side of this left-handed or left-pointing flatfish is entirely normal. The coloration is normal save that the 6 or 8 brownish or dark spots have disappeared through the action of the preservative. The eyes are both on the left side, the rotating eye is clear of the dorsal crest and

there is no deformity of the anterior part of the dorsal fin. Certainly there is nothing on the upper surface either in color or structure to indicate what is to be found on the under side.

Instead of a totally white under surface one finds the situation shown in part in Figure 1. Forward from the tip of the caudal fin to the gill cover and head, the fish is as dark below as above, the dark color extending forward on the throat clear to the isthmus. The gill cover and the whole under surface of the head are white except for a narrow dark strip on the upper head at the base of the dorsal fin which extended clear to its forward extremity. On the hinder projection of the operculum there are two or three rather faint dark areas whose color is due to pigment patches not on the outside but in the tissues lining the inner surface of the operculum.

The extent of the dark area on the lower surface clear up to the head is not accompanied by and has not caused any other abnormalities. As a matter of fact the anterior section of the lateral line on the blind side is better developed and more normal than the corresponding section on the eyed side. Another difference, perceptible only after careful scrutiny, is that the scales on the white side of the head are slightly smaller than those on the dark side.

Many authors have alleged that flatfishes with considerable color below have the lower side musculature as well developed as that of the upper. To the eye, viewing the fish vertically and longitudinally to compare sides, both sides seem equally developed. But, to test the matter, in the region just above the backbone and in the same level, cuts were made down to the neural spines. The thickness of the muscles below was 9 mm., of those above, 10 mm. Thus both eye and measurement confirm the idea generally held.

II.—A PARTIALLY AMBICOLORATE RUSTY DAB *Limanda ferruginea*

This specimen was taken in a trap just outside the Gloucester, Massachusetts, breakwater on July 18, 1934, and was sent to Mr. Firth by the trap owner. It was frozen and shipped by express to the Museum, where it was received in apparently good condition, but it went to pieces badly when put into alcohol.

This dab is 17 in. long over all, and 7 in. deep (body only); it weighs 19 oz. I have been unable to ascertain the ranges in size and weight of the rusty dab, but this specimen is undoubtedly adult and presumably

of a relatively average size. *Limanda ferruginea* is a northern fish not often taken south of the Woods Hole region.

This dextral or right-pointing fish is entirely normal on the eyed or upper surface save in the anterior part of the lateral line. This branches at a point in a vertical line dividing the head in two. The forward extension runs to the hinder edge of the rotated eye. The other branch runs backward about parallel with the base of the dorsal fin for a distance of 7 scales and then turns obliquely downward a distance of 6 scales.

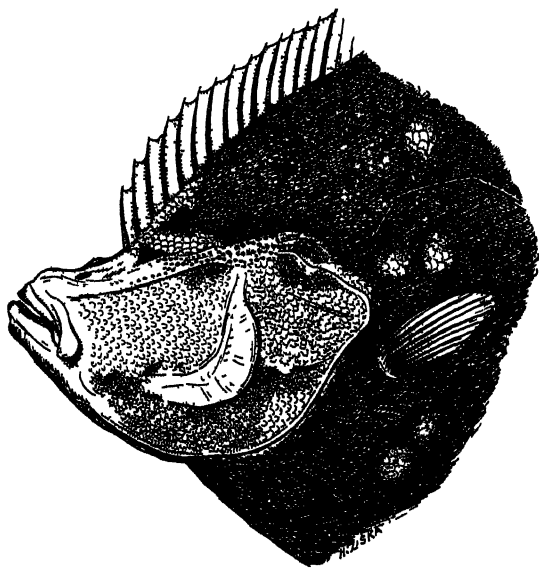


Fig. 2. Lower side of head region of a partially ambicolorate right-pointing *Limanda ferruginea*. The lower side is colored like the upper, save for some white spots on the body and the dark color on lower part of head as shown. $\times \frac{1}{2}$.

The lower surface is in general colored like the upper from the tip of the caudal fin clear up to the head, including the opercular region. There are, however, a number of rather small, relatively obscure, lighter colored areas scattered about. The three largest of these are in the middle part of the body and above the lateral line. Whether the scales in this region are albinistic or whether the thin colored epidermis has slipped from the scales I cannot say positively, but I am inclined to think them albinistic, since under a glass many of these white scales show numerous minute dark pigment spots.

However, our greatest interest is in the head. The subopercle is colored throughout most of its extent as Figure 2 shows. In front a little color has crept up onto the cheek. As in the summer flounder, there is color in the tissues lining the hinder part of the operculum and making this region look dark when it is really white. There is a small patch of pigment on the upper part of the opercular region. There is another patch on the head forward of the last, and still another under the anterior base of the dorsal fin. There is also faint pigmentation under the hinder end of the maxillary. On the upper part of the gill cover and on the corresponding parts of the shoulder region and the head as far forward as the anterior dorsal spine, the scales are reduced in size and are markedly spinose. This region is very rough to the finger. All these characters are shown in Figure 2.

This is the first dab that I have ever seen, and when the specimen was unpacked I was led to think that there was before me a case of head anomalies. This conclusion was based on the large amount of pigmentation on the under side of the head, on the concave forehead, and on the very high position (dorsally speaking) of the rotated eye. But Mr. Nichols looked up a figure of a normal *Limanda ferruginea* and showed me that the deeply concave forehead and the highly placed left eye are normal characters of this species.

The absence of head anomalies, even though there is present a very large amount of pigmentation on the lower surface of the fish, is correlated with the fact that the head coloration is practically confined to the gill cover. In this respect, this fish agrees with what has been found in an extensive study (to be published later) of all the known records of partially ambicolorate flatfishes. Furthermore there is further correlation with the presence of white patches (the three largest of which are about the size of a finger nail) scattered over the dark under surface. There are two cases in the literature of European flatfishes with lower side coloration almost parallel to this one. These will all be considered later in a general study of partial or incomplete ambicoloration which is in progress.

To the eye the blind side musculature of *L. ferruginea* does not seem as well developed as that of the upper side,—the lower side looked flat or even slightly concave. Dissection and measurements give the thickness down to the neural spines as 7 mm. below and 9 mm. above. However, it must be remembered that this fish had been frozen for shipment and it is quite possible that this may have affected not merely the appearance but the actual thickness after being thawed and put in al-

cohol. At any rate one cannot be so sure of the condition in this fish as in the much better preserved *Paralichthys dentatus*.

There are in the literature two other records of flatfishes with a considerable amount of color on the lower head parts but with a good deal of white scattered throughout the lower dark area. The balance of light and dark areas has in all cases seemingly prevented the formation of any head anomalies. One of these fishes is Hussakof's *P. dentatus* shown in Figure 3. These cases will all be considered in the general paper referred to.

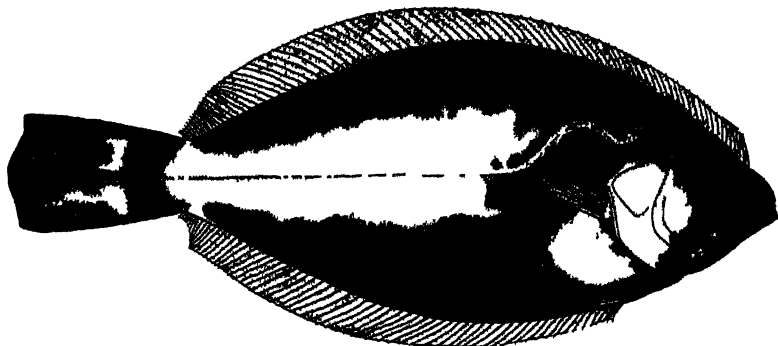


Fig. 3. Under side of a partially ambicorate *Paralichthys dentatus*. This is the most unusually colored flatfish ever figured. The large amount of dark color on the head seems to be balanced by the large areas of white on head and body, and hence other head anomalies are absent. After Hussakof, 1914.

If the lateral line on the upper surface, as described above, is at all normal, that below is certainly abnormal. In a vertical of the hinder third of the operculum, it dips down to this and abruptly ceases where opercle and head become confluent.

GENERAL NOTES

I have been at work for a year and a half on the problem of abnormal coloration of flatfishes. The data are enormous and chaotic. That for reversal has been worked up, and study is in progress on that for partial ambicoloration. From the work on the latter subject a few brief notes will be added pertaining to my specimens. Such data for American flatfishes are few.

Paralichthys dentatus.—The summer flounder seems more given to partial ambicoloration than most American flatfishes. In addition to the specimen described herein, Hussakof (1914) has described two partially ambicorate fish from Cape Lookout. One of these had the hinder half

of the body dark-colored plus a dark peninsula projecting forward on the ventral surface clear up to the throat. The other was such an unusually colored specimen that Hussakof's figure is introduced here as my Figure 3 in place of a description. Here, as in my dab, the large amount of dark on the head is balanced by the larger areas of white on head and body, and eye and dorsal fin anomalies are absent. These fish are the only partially ambicolorate specimens of *P. dentatus* heretofore on record.

However, after the above was written, Mr. John C. Pearson, of the U. S. Bureau of Fisheries, wrote me that some years ago he examined two ambicolorate specimens of *Paralichthys dentatus* "from the catch of a winter trawler off the Virginia or North Carolina coast." The first, an incompletely ambicolorate fish, had the dark color covering approximately the hinder half of the lower surface, the forward section being white. As is to be expected, there was neither eye nor dorsal fin abnormality. The second specimen was completely ambicolorate save for a small white patch in the region of the gill cover. As is always found in cases of extreme ambicoloration, the dorsal fin was strongly hooked, and the right or rotating eye was arrested when it had got barely over the dorsal crest. These conditions closely parallel what I have previously described in a nearly completely ambicolorate *Pseudopleuronectes americanus* (Gudger, 1934).

These specimens belong to the collections of the U. S. Bureau of Fisheries, but when the Bureau moved to the new Department of Commerce Building, they were misplaced and at present are not available for study. I greatly regret that I am unable to give a detailed description of the second fish. But Mr. Pearson's letter enables me correctly to add this fish to the category of practically completely ambicolorate flatfishes with eye and dorsal fin anomalies.

It is significant that five ambicolorate flounders of the same species (*P. dentatus*) have been captured in the same general region—Hussakof's two from off Cape Lookout, my one fish from off Cape Henry, and Mr. Pearson's two from off the Virginia-Carolina coast. It would be of very great interest to examine large catches of this flounder from this general region, to ascertain if the abnormal fish occur sporadically or if they are found in any considerable numbers. No explanation for this seeming prevalence can be offered.

Limanda ferruginea.—The rusty dab, so far as I know, has never before been found in our waters with any degree of ambicoloration. This abnormality has been much described in European flatfishes, and among

these, eleven cases have been found on record for the European dab, *Limanda limanda*. Since these European specimens will be described in the general paper referred to, it is not necessary to refer to them further here.

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MAMMALS COLLECTED IN KAZAKSTAN, CENTRAL ASIA, BY
THE MORDEN-GRAVES NORTH ASIATIC EXPEDITION,
WITH THE DESCRIPTION OF A NEW GROUND
SQUIRREL

BY G. G. GOODWIN

The trip undertaken by the Morden-Graves Expedition in Central Asia during the fall of 1929 was made primarily for a group of saiga for the North Asiatic Hall of The American Museum of Natural History.

Leaving the Orenburg and Tashkent Railway at Kizil Orda (marked on most maps Perovsk) on October 7, 1929, we traveled northeast, at first through flat areas where water was plentiful and reedy ponds and small lakes were scattered, and later through alternate arid steppe country and dry, sandy desert areas. During the first day we crossed a small but fairly swift river, which I understood to be a confluent of the Syr Darya, then north to Tele Kul, a chain of shallow, flat, mud lakes, where water fowl were abundant and golden eagles and small flocks of sand grouse were frequently seen in the surrounding steppes. After a few days were spent collecting here, we moved north through typical steppe country, vast, arid, flat plains, with little vegetation and stretches glistening white with caked salt, to an escarpment at Tuz Bulak, about one hundred and fifty miles north of Kizil Orda. Gerund (*Gazella subgutturosa*) were frequently seen in small bands of five or six on the open steppes. Most of the small mammals collected were secured here. The expedition then traveled about one hundred miles north toward the Sari-Su, where saiga were eventually secured by Mr. Morden.

Acknowledgment is due to Mr. William J. Morden and the late Mr. George C. Graves, 2d, who organized and led the expedition and assisted me in collecting the small mammals.

***Hemiechinus calligoni turkestanicus* Ognev**

Turkestan Long-eared Hedgehog

Hemiechinus calligoni turkestanicus OGNEV, 1928, 'Mammals of Eastern Europe and Northern Asia,' I, p. 130.

Two specimens: Tuz Bulak, one hundred and fifty miles north of Kizil Orda (Perovsk), Kazakstan, 600 feet elevation.

A small long-eared hedgehog with white under parts, dark face, proportionally short spines; relatively narrow rostrum and narrow inter-orbital space; similar in color to *H. c. calligoni*, but the skull is a little more elongate and rostrum narrower; tooth rows longer than in the typical form.

Color of two subadult specimens from Tuz Bulak, taken in October, 1929: spines creamy white with a blackish-brown base and broad blackish-brown ring near the short white tip; crown of head and cheeks tawny olive,¹ this color extending backward below ears to back and in a narrow lateral line on the margin which separates the spiny surface from the fur; muzzle, from eyes to end of snout, blackish brown; ears sparsely covered with creamy-white hairs; upper surface of fore and hind feet sepia; tail sparsely covered with stiff dusky hairs; entire under parts, including lower lip, chin, and fore and hind limbs to ankles creamy white.

Measurements: total length from nose to end of tail, 180, 150 mm.; tail vertebrae, 15, 17 mm.; hind foot with claws, 35, 39 mm. (36 mm. in the dried skin); ear from notch, in dried skin, 32, 30. mm. Skull: condylobasal length, 43.5, 43 mm.; basal length, 40.5, 40.2 mm.; length of nasals, 15.2, 14 mm.; greatest width of nasals, 3.2, 3.5 mm.; zygomatic breadth, 24.5, 24.3 mm.; interorbital constriction, 12.6, 12 mm.; post-orbital constriction, 11.1, 12 mm.; greatest outside width across molars, 16.7, 16.7 mm.; length of upper tooth row, 23, 23.2 mm.

The present specimens were taken in a dry, narrow ditch at the foot of an escarpment about one hundred and fifty miles north of the type locality for *H. c. turkestanicus*. Measurements and characters of the Tuz Bulak specimens agree closely with the figures and type description given by Ognev. The spines in our specimens, however, are much shorter (18 mm.) and more slender than in the type series (21.5 mm.). Lack of material has prevented me from comparing these specimens with any of the central Asiatic species of small hedgehogs; from *H. a. minor* it apparently differs in smaller size and narrower rostrum, and from *H. russoni* in its longer ears and darker color.

***Crocidura suaveolens mordeni* Goodwin**

Morden White-toothed Shrew

Crocidura suaveolens mordeni GOODWIN, 1934, Amer. Mus. Novit., No. 742.

Nine specimens: Tuz Bulak, 7; Tele Kul, 2.

A small pale-colored white-toothed shrew about the size and general proportions of *C. lignicolor* Miller, but color paler, under parts nearly pure

¹Color Standards and Nomenclature, Ridgway.

white, this color extending well up over sides of body and face; tail relatively long, distinctly bicolor, the line of demarcation sharply indicated; pelage moderately long and soft.

Color of type specimen from Tuz Bulak: upper parts, including upper surface of tail, uniform, between Verona brown and wood-brown; fore and hind limbs, feet, lips, cheeks to eye, base of ear, and entire under parts, white, lightly washed with pale buff. The dorsal area in the six paratypes varies in color from Verona brown to pale wood-brown, but under parts throughout the series are white.

Skull about the size and general proportions of *C. lignicolor*; the length of the upper tooth row averages slightly longer than in typical specimens from Djarkent, eastern Turkestan, but general characters are essentially the same.

Measurements of type and average of five paratypes (taken in the flesh): total length, 90, 90.4 mm. (87-95); length of tail vertebrae, 30, 30.8 mm. (30-32); hind foot, including claws, 12.5, 12.3 mm. (12-12.5). Skull: condylobasal length, 16.8, 17.2 mm. (16.7-18.5); least inter-orbital breadth, 4, 4 mm. (3.8-4.3); greatest breadth of brain case, 8.2, 8.3 mm. (8.1-8.7); length of entire maxillary tooth row, 7.9, 8.1 mm. (7.8-8.2).

C. s. mordeni can readily be distinguished from *C. lignicolor* by its white under parts and more sharply bicolor tail. I have not compared it with *C. ilensis* Miller from Ili, but from the type description it differs in color, smaller feet, and some cranial characters. The type and six paratypes were taken in the open steppe country and in narrow ditches at the foot of an escarpment where the water from springs trickled down and dried up on the desert. Two specimens were taken at Tele Kul, sea level, in the flat alkali lake district.

***Putorius eversmanni eversmanni* (Lesson)**

Steppe Polecat

Mustela Eversmanni LESSON, 1827, 'Manuel de Mammalogie ou Histoire Naturelle des Mammifères,' Paris, p. 144.

One specimen: adult female, from Kal-gach, two hundred and fifty miles north of Kizil Orda (Perovsk), Kazakstan.

A small soiled whitish animal, with a long body and short black limbs.

Color of specimen from Kal-gach, taken October 28, 1929: fur creamy white washed with long black-tipped guard hairs; head creamy white with a broad blackish-brown band across the face and eyes and

almost to corner of mouth; fore and hind limbs and feet, under side of neck and breast, black; an indistinct blackish-brown patch of hairs in front of ear; distal half of tail black.

Measurements of adult female (taken in the flesh): total length, 423 mm.; tail vertebrae, 115 mm.; hind foot, 40 mm. Skull: condylo-basal length, 55.6 mm.; zygomatic breadth, 32 mm.; interorbital constriction, 14.8 mm.; distance from front of canine to back of last molar, 18.4 mm.

The present specimen was found ambling along on the open steppe country.

***Vulpes vulpes karagan* (Erxleben)**

Karagan Fox

Canis Karagan PALLAS, 1771, 'Reise durch verschiedenc Provinzen des Russischen Reichs,' I, pp. 200, 234.

One specimen: two hundred miles north of Kizil Orda (Perovsk), Kazakstan; purchased alive from the natives, apparently a pet animal.

The Karagan fox is a moderately large pale-colored form with a comparatively long tail and coarse loose fur.

Color of an adult female specimen from the Kirghiz Steppes, killed October 28, 1929: fur on back rich ochraceous tawny mixed with light buff-tipped guard hairs; crown of head, middle of neck, base of ears and shoulders clear bright ochraceous buff; sides of neck and body warm buff; tip of ears broadly black; end of muzzle and upper lip white, lower lip white, but with a narrow margin of dark gray; front of hind legs bright ochraceous tawny with a small spot of black-tipped hairs at base of toes; front of fore legs with a rather broad stripe of light buff hairs tipped with black; tail pale light buff with a mixture of black-tipped hairs, tip of tail white; inguinal region white; throat and a narrow stripe on middle of belly plumbeous washed with soiled whitish.

The skull is moderately large, facial region narrow, brain case short, teeth rather weak.

Measurements of adult female: total length, 1005 mm.; tail vertebrae, 370 mm.; hind foot, 150 mm. Skull: greatest length, 139.5 mm.; condylobasal length, 135 mm.; zygomatic breadth, 71 mm.; breadth of brain case, 46 mm.; greatest outside breadth across molars, 41.75 mm.; length of nasals, 53 mm.; length of upper tooth row from front of canine to back of last molar, 64 mm.

The Karagan fox apparently inhabits the low subdesert country of the Kirghiz Steppes. I saw tracks of several foxes in the sand on an

escarpment at Tuz Bulak; it is frequently taken young by the Kirghiz and kept as a pet, and a native caravan is hardly complete without a fox riding on the back of a camel.

***Citellus pygmaeus kazakstanicus*, new subspecies**

TYPE. — No. 85310, Amer. Mus. Nat. Hist.; male adult; Tuz Bulak, one hundred and fifty miles north of Kizil Orda (Perovsk), Kazakstan, Central Asia, altitude 600 feet; October 17, 1929; collector, George G. Goodwin. The type is a skin in good condition and skull with brain case and occiput broken.

GENERAL CHARACTERS. — A small pale-colored ground squirrel with a unicolor tail which is less than one quarter the length of head and body.

DESCRIPTION. — Color of type specimen from Tuz Bulak: upper parts warm buff, darkest on mid-dorsal area, with insignificant pied markings caused by dusky and pale yellow rings around each hair; crown of head bright ochraceous buff; sides of body, fore and hind limbs, feet, lower part of cheeks between warm buff and light buff, a light buffy ring around eyes; tail deep warm buff; under parts light buff, the plumbeous basal color showing through. Cranial characters about as in typical *C. p. pygmaeus*.

MEASUREMENTS (taken in the flesh). — Total length, 190 mm.; tail vertebrae, 35 mm.; hind foot, including claws, 33 mm. Skull: zygomatic breadth, 26 mm.; interorbital breadth, 7 mm.; length of nasals, 13 mm.; alveolar length of upper molar tooth row, 9.5 mm.

Skin of *C. pygmaeus kazakstanicus*, compared with typical *C. p. pygmaeus* from the lower Volga region, is much paler in color. *C. p. herbicola* Martino from northern Kazakstan, its nearest geographical subspecies, is even darker than the typical form. I have not compared the present specimen with *C. p. brevicauda* Brandt from the Zaisan River, but it is, apparently, much paler and less reddish in color.

This specimen was taken in a scanty growth of low sagebrush in the open steppe country. Apparently most of its kind had already hibernated for the winter as I found plenty of ground squirrel holes, but extensive trapping yielded no further specimens.

***Allactaga elater elater* (Lichenstein)**

Kirghiz Steppes Big-eared Jerboa

Dipus elater ЛИЧЕНШТЕЙН, 1825, 'Über du Springnause,' Abh. d. Berlin Akad. d. Wiss., p. 155.

Five specimens: Tuz Bulak, one hundred and fifty miles north of Kizil Orda (Perovsk), Kirghiz Steppes, Kazakstan, 4 skins and skulls, 1 alcoholic.

A medium-sized jerboa with large ears, long tail and large hind feet.

Color of specimens from Tuz Bulak, taken in October, 1929: upper

parts, including crown of head, warm buff, tips of fur washed with blackish brown, heaviest on mid-dorsal area and rump; base of fur plumbeous; side of body, face, outside of hind limbs and shoulders slightly paler buff than back and lightly washed with blackish, base of fur white; a broad stripe of pure white hairs across hips meeting white of belly below tail; a patch of black hairs below white stripe on posterior outside of hind limbs; outside of ears warm buff, inside sparsely covered with soiled whitish hairs, inside rim warm buff; under parts, including fore limbs, feet, inner side of hind limbs and upper side of hind feet, toes and cheeks white to base of fur; under side of hind feet sparsely covered with brownish-black hairs, below, clear warm buff grading to light buff posteriorly; brush, subterminal area black for 31.5 mm., preceded by a narrow band of light buff, tip pure white, the black area meeting on midventral line in most specimens but divided by a white line in others. Skull: upper premolar much reduced; present upper incisors protruding but not grooved; interorbital constriction relatively broad; tympanic bullae not extensively inflated; incisive foramina extending backward not farther than the anterior border of first molar.

Measurements of one adult male and two adult females from Tuz Bulak: total length, 260, 265, 255 mm.; tail vertebrae, 160, 163, 155 mm.; hind foot, 56, 57, 53 mm.; ear from notch, in dried skin, 25.3, 25, 25 mm. Skull: condylobasal length, 25.3, 24.9 mm.; zygomatic breadth, 19.5, 20.1, 19.5 mm.; length of nasals, 9.2, 9.2, 8.8 mm.; interorbital constriction, 8.5, 9.5, 9.2 mm.; alveolar length of upper tooth row, 5.0, 5.05, 4.9 mm.

The five specimens were taken at about 600 feet elevation in small areas of sagebrush in the flat, sparsely grassed steppe country. Its habits appear to be much the same as those of *A. acontion* though it possibly inhabits a somewhat higher plain and more fertile country than *A. acontion*. *A. elater* was originally described from the Kirghiz Steppes and the present series is probably typical.

***Alactagulus acontion acontion* (Pallas)**

Kirghiz Steppes Little Jerboa

Dipus acontion PALLAS, 1811, 'Zoographia Rosso-Asiatica,' Tome I, p. 182.

Three specimens: Tele Kul, seventy-five miles northeast of Kizil Orda (Perovsk), Kazakstan.

A rather small pale-colored jerboa with moderately large ears, long tail and well-developed hind limbs.

Color of specimens from Tele Kul, taken in October, 1929: upper

parts, including ears, crown of head and outer side of hind limbs light buff, tips of fur blackish brown, base of fur plumbeous, clear light buff on head and ears; sides of body paler than back, base of fur white, a stripe of pure white hairs across hips; under parts, including fore limbs and fore feet, inner side of hind limbs and hind feet white to base of fur; tail above, warm buff mixed with brownish-black fur on basal two-thirds; subterminal area of brush black for 17 mm., preceded by a band of light buff, tip white, under side of tail to brush warm buff, the black area almost but not quite meeting in a narrow band on midventral line. Cranial characters: tympanic bullae not extensively inflated and not in contact with each other; upper incisors protruding forward and not grooved; upper premolar absent; anterior end of nasals not reaching the level of alveoli of upper incisors.

Measurements of one adult male and two semiadult males from Tele Kul: total length, 245, 220, 205 mm.; tail vertebrae, 135, 135, 120 mm.; hind foot, 47, 47, 45 mm.; length of ear from notch, in dried skins, 21, 20.5, 20.5 mm. Skull: condylobasal length, 24.8, 23, 21.5 mm.; zygomatic breadth, 21.4, 20.2, 18.6 mm.; length of nasal, 10, 8, 8 mm.; alveolar length of upper tooth row, 5, 4.8, 4.6 mm.; interorbital constriction, 8.3, 7.9, 7.5 mm.

The present three specimens were taken at sea level in the low sagebrush on a flat, sandy, alkali plain at Tele Kul, Kirghiz Steppes. The traps were set at the top of burrows and the specimens were taken during the night; the temperature at the time ranged from 30 to 32° Fahrenheit.

***Mus musculus wagneri* Eversmann**

Wagner Mouse

Mus Wagneri EVERSMANN, 1848, Bull. Soc. Nat. Moscou, XXI, part 1, p. 191, Tab. 1, fig. 2.

Twenty-six specimens: Tuz Bulak, one hundred and fifty miles north of Kizil Orda (Perovsk), Kazakstan, 11 skins and skulls, 5 alcoholic specimens; Tele Kul, seventy-five miles northeast of Kizil Orda, 7 skins and skulls, 3 alcoholic specimens.

A small buff-colored mouse with a relatively long tail, similar to the common house mouse but smaller in size and much lighter in color.

Color in the present large series shows very little individual variation: upper parts pinkish buff washed with blackish-tipped hairs; sides of head and body slightly paler than back, this color extending down the upper sides of fore and hind limbs to ankles; fore and hind feet white; tail indistinctly bicolor, sparsely covered with short stiff hairs, dusky

above, whitish below; entire under parts white, base of the fur irregularly plumbeous.

Skull small and weak, the anterior palatine foramina extending posteriorly to about the middle of first molar.

Measurements, average of five largest specimens from Tuz Bulak: total length, 135 mm. (133–145); tail vertebrae, 60 mm. (54–65); hind foot, 17 mm. (16.5–18.5). Skull: condylobasal length, 20 mm. (19.5–20.5); zygomatic breadth, 11.1 mm. (10.8–11.5); interorbital constriction, 3.4 mm. (3.4–3.4); alveolar length of upper molar series, 3.4 mm. (3.3–3.5).

The Wagner mouse is an inhabitant of the Kirghiz Steppes. It is common throughout Turkestan and is found in the cultivated districts and on the grassy steppes from sea level to about 4000 feet elevation.

***Cricetulus migratorius migratorius* (Pallas)**

Pallas Hamster

Mus migratorius PALLAS, 1773, 'Reise durch verschiedenc Provinzen des Russichen Reichs,' II, p. 703.

Four specimens: Tuz Bulak, one hundred and fifty miles north of Kizil Orda (Perovsk), Kazakstan, 3 skins and skulls, 1 alcoholic specimen.

The Pallas hamster is a pale-colored vole, without a dark mid-dorsal stripe or markings on the head; under side of fore and hind feet partly covered with hair; tail short, unicolor; under parts white.

Color of specimens from Tuz Bulak: upper parts, including crown of head to end of nose and below eyes, light buff lightly washed with blackish brown-tipped hairs, this color extending down outside of hind limbs nearly to ankles; under parts, including fore and hind feet, fore limbs and inner side of hind limbs, and tail, are white, this color extending well up on shoulders and sides of paw; ears with indistinct buffy white border, outside of ears blackish brown, inside light buff; immature specimens darker and grayer than adults; mammae, eight.

Measurements of adult male and female, respectively, from Kizil Orda: total length, 128, 120 mm.; tail vertebrae, 24, 20 mm.; hind foot with claw, 17, 17 mm. Skull: condylobasal length, 25.5, 27.2 mm.; zygomatic breadth, 14.2, 14 mm.; least interorbital constriction, 4, 4 mm.; length of nasals, 10, 10 mm.; alveolar length of upper molar series, 4.2, 4 mm.

This hamster was taken on a dry, sandy escarpment at an elevation of 600 feet; it lived in holes in the ground or under rocks in open arid country where there was little or no cover.

The hamsters of Central Asia are not very well known. I have referred the present series to the above species. It agrees in measurements and general characters with Pallas' description, but differs appreciably from *C. accedula* Pallas of which it has been considered a synonym.

***Microtus (Phaiomys) gravesi* Goodwin**

Graves' Vole

Microtus gravesi GOODWIN, 1934, Amer. Mus. Novit., No. 742.

Five specimens: Tuz Bulak, 4 skins and skulls, 1 alcoholic.

A small light-colored vole with a short tail, ears small but not concealed in the fur; bullae much inflated; externally very similar to *Phaiomys blythi* from Ladak, India, but smaller with relatively shorter tail; smaller feet and widely different cranial characters. Fur long and soft, under side of feet moderately overgrown with hair, but toes and foot-pads naked. Last upper molar with four well-developed projecting angles on inner side. *M. gravesi* is probably an aberrant form of *Phaiomys*.

Color of four specimens from Tuz Bulak uniform: upper parts, hair pinkish buff subterminally, tips dark brown, darkest on posterior dorsal area; fore and hind feet buffy white; tail indistinctly bicolor, light buff with a weak middle dusky stripe along the dorsal surface; under parts light buff, the plumbeous basal color showing through.

Skull angular and broad, with two low, distinct bow-shaped middle or lateral crests; audital bullae large, their walls strengthened by dense spongy bone tissue, inflated, and forming prominences on the sides of the occiput; interorbital area narrow, expanding abruptly posteriorly; the last upper molar with four well-developed projecting angles on inner side. The dorsal surface of the skull resembles Vinogradov's figure of *Phaiomys bucharensis* in his 'Key to the Rodents of Middle Asia,' but differs in having four well-developed projecting angles on inner side of last upper molar instead of three as designated for *Phaiomys* by Dr. Vinogradov.

Measurements of type and average of three paratypes: total length, 120, 117 mm. (113-120); length of tail vertebrae, 25, 22 mm. (20-25); hind foot, including claws, 18, 17.6 mm. (17-18). Skull: condylobasal length, 26, 26.1 mm. (25.8); zygomatic breadth, 15.5, 15.2 mm. (15-15.3); least interorbital breadth, 3.4, 3.7 mm. (3.5-3.8); mastoid breadth, taken just behind the auditory meatus, 12.6, 12.5 mm. (12.5-12.5); length of nasals, 7.5, 7 mm. (7.7); alveolar length of upper molar series, 6.2, 6 mm. (6.6).

This vole was taken in scattered clumps of grass near small springs that trickled down the side of an escarpment and dried up on the sand. It was active at most hours of the day and lived in holes or burrows in the ground and fed on the succulent bases of the grasses. Apparently it is rather local and not abundant. It was difficult to trap, and two of the five specimens I caught with my hands.

***Meriones tamaricinus jaxartensis* (Ogneff-Heptner)**

Aral Sea Jerboa

Gerbillus tamaricinus jaxartensis OGNEFF-HEPTNER, 1928, March 1, Zool. Anzeiger, LXXV, No. 11-12, p. 264.

Six specimens: Tuz Bulak, one hundred and fifty miles north of Kizil Orda (Pervosk), Kazakstan, 4; Tele Kul, seventy-five miles northeast of Kizil Orda, 2.

The Aral Sea jerboa is a large rich buff-colored form with a white spot over eyes, under parts white to base of fur, lighter colored than typical *M. tamaricinus* from the mouth of the Ural and less pinkish than *M. t. rokkandicus* from the Ferghana district.

Color of specimens from Tuz Bulak: upper parts, including crown of head and upper side of hind limbs, cinnamon buff, tips of hair bister-black, darkest on rumps; specimens from Tele Kul darker, about clay color; sides of body, upper side of fore limbs and side of head pinkish buff, blackish tips of hair less pronounced than on back; outer side of ear about color of back, margin indistinctly whitish, a small tuft of white hairs at posterior base of ear; a large white spot above eye to base of ear, an indistinct narrow black ring around eye; under part, including upper side of fore and hind feet, under side of fore and hind limbs, lips, chin, and well up on sides of cheeks, belly, white or creamy white to base of fur; under side of fore feet naked; ankles and under side of hind feet from heel to base of toes blackish; under side of hind toes more or less naked; tail above cinnamon-buff heavily mixed with bister, almost black, sides of tail cinnamon-buff, under side of tail light buff or warm buff, cinnamon-buff at base; tip bister, almost black, grading into color of tail above; claws pale brownish, tips white, in some specimens fore claws all white.

Skull: bullae well rounded but not excessively inflated. Anterior palatine foramina not extending posteriorly to line of anterior border of first molars, anterior face of upper incisor ochraceous orange with one groove.

Measurements of two adult males from Tuz Bulak and one subadult male from Tele Kul, respectively: total length, 300, 285, 250 mm.; tail

vertebrae, 130, 145, 120 mm.; hind foot, 40, 41, 37 mm. Skull: one adult male from Tuz Bulak and one subadult male from Tele Kul, greatest length (from tip of nasals to occipital plane), 42.3, 40.4 mm.; condylobasal length, 38, 36 mm.; zygomatic breadth, 23.5, 21.5 mm.; interorbital constriction, 7.2, 7.2 mm.; length of nasals, 17, 17 mm.; length of anterior palatine foramina, 75, 7 mm.; length of upper molar series, 6.5, 6 mm.

M. t. jaxartensis is described as sandy red, distinctly lighter in color than typical *M. tamaricinus*. No measurements were given. The type locality is Kara Usiak on the Orenburg and Tashkent Railroad, not more than one hundred and fifty miles from the locality of the present series.

Four of our specimens were taken in the sand dunes on an escarpment at Tuz Bulak, 600 feet elevation, and are a uniform light-colored series. A subadult male from Tele Kul, sea level, taken in the tall reeds at the side of an alkali lake, is somewhat darker and richer colored with a shorter tail than the Tuz Bulak series. Cranial characters are also somewhat different, the skull being lighter with weaker teeth. These differences, however, I am inclined to consider as individual or local variations and to refer the whole series to *M. t. jaxartensis* for the present.

***Pallasiomys meridianus massagetes* Heptner**

Aral Sea Yellow-tailed Jerboa

Pallasiomys meridianus massagetes HEPTNER, 1933 (December 20), Zeitschrift f. Säugetierkunde, VIII, part 3, p. 155.

One specimen: Tuz Bulak, one hundred and fifty miles north of Kizil Orda (Perovsk), Kazakstan.

A small sandy-colored jerboa with a light yellowish tail; fur on entire under parts and feet white to base of hairs; claws white, thumb small with vestigial claws.

Skull with bullae extensively inflated, upper incisors with one groove on anterior surface.

Color of one specimen from Tuz Bulak: upper parts, including crown of head to nose, cinnamon-buff, mixed with black-tipped hairs; ear about color of back, sides of body, head, pinkish buff lightly washed with black-tipped hairs, an indistinct whitish spot above eye; upper side of hind limbs to ankles nearly clear pinkish buff; entire under parts, including upper and under side of fore limbs and feet, under side of hind limbs and upper and under side of hind feet, lips, chin, and well up on cheeks are white to base of fur; tail above bright clay color mixed with a few scattered black-tipped hairs; under side light buff divided by a mid-

vertical line of cinnamon-buff; pads of fore feet naked; fingers and entire under side of hind feet hairy; claws white; upper incisors zinc-orange. Skull: bullae extensively inflated but relatively small for *M. meridianus*; anterior palatine foramina extends posteriorly to a line across anterior border of alveoli of first molars.

Measurements (taken in the flesh): total length, 200 mm.; tail vertebrae, 100 mm.; hind foot, including claws, 30 mm. Skull: greatest length from nasals to occipital plane, 31 mm.; condylobasal length, 27 mm.; basal length, 25.2 mm.; length of nasals, 12 mm.; length of anterior palatine foramina, 5.5 mm.; greatest breadth across bullae, 17.1 mm.; interorbital constriction, 6 mm.; alveolar length of upper molar series, 4.2 mm.

This specimen was taken in a sparse growth of low sagebrush in the open flat steppe country.

***Pallasiomys erythrourus eversmanni* (Bogdanov)**

Eversmann Jerboa

Meriones eversmanni BOGDANOV, 1875, Travaux Soc. Nat. de St. Petersburg, VI, p. 266.

Twenty-four specimens: Tuz Bulak, one hundred and fifty miles north of Kizil Orda (Perovsk), Kazakstan, 1 alcoholic, 23 skins and skulls.

The Eversmann jerboa is a medium-sized sandy-colored species with color of fur at the base plumbeous. Skull with large bullae, narrow rostrum, and one groove on anterior face of upper incisor.

Color of specimens from Tuz Bulak: upper parts, including crown of head to nose, cinnamon-buff; tips of fur blackish, plumbeous at base and sparsely mixed with a few black hairs; sides of head and body slightly paler than back, about warm buff mixed with black-tipped hairs; upper side of fore and hind limbs to ankles and an indistinct lateral line pinkish warm buff; upper side of hind feet pale light-buff with an irregular line of warm buff down outer side, sometimes spreading over entire surface and absent in others; an indistinct buffy patch behind eye in some specimens; a light buffy spot at posterior base of ear, outside of ear about color of back, inside light buff; a clear cinnamon-buff patch at base of whiskers; whiskers, upper half black, lower half white; basic color of tail uniform, between clay color and ochraceous buff mixed with black-tipped hairs, clear below at base and sides for about half its length, tip black, which color extends along upper side for 50 mm., gradually blending with rest of tail; under part of body, including belly to throat and under side of hind limbs, creamy white, base of fur plumbeous;

lips, throat, under side of fore limbs white to base of fur; soles of fore feet and toes naked; under side of hind feet and toes hairy, except parts on toes and heels to center of foot hairless; nails on fore and hind feet blackish brown, tips white.

Skull: bullae large and inflated, extending well forward and in contact with posterior border of zygomatic arches and backward to occipital plane, spreading outward a little wider than zygomatic breadth; zygomatic arches weak, not angular, and narrower anteriorly than posteriorly; rostrum narrow elongate with relatively long narrow nasals; anterior palatine foramina long, extending posteriorly to anterior border of first molar; posterior palatine foramina normal; upper incisors orange-buff with one groove on anterior surface.

Measurements, average of five largest adult males and females from Tuz Bulak: total length, 277 mm. (270–280); tail vertebrae, 139 mm. (135–140); hind foot, 35.4 mm. (35–36). Skull: greatest length from tip of nasal to occipital condyle, 38.7 mm. (38.2–39.5); condylobasal length, 34.3 mm. (33.7–35.3); zygomatic breadth, 20.8 mm. (20.5–21.2); greatest breadth across bullae, 21.2 mm. (21–21.7); interorbital constriction, 6.7 mm. (6.5–7); length of nasals, 14.5 mm. (14–15); length of anterior palatine foramina, 6 mm. (5.7–6.6); length of upper molar series, 5.6 mm. (5.3–5.7).

The Eversmann jerboa was abundant locally in the arid steppe country north of Kizil Orda. The present series were taken at the base of a low escarpment at Tuz Bulak, where the dry, sandy soil was packed hard and the scant vegetation consisted of clumps of low sagebrush and a scattered growth of coarse grass. It apparently lived in small colonies, the burrows occupying an area about ten feet in diameter with about twelve holes in the colony. It was active during most of the day and frequently was seen about in the bright sunlight in the early afternoon. In the distance it appeared to amble along in much the same way as the common house rat, and at the first sign of danger it retreated to the burrow and rarely reappeared on the surface until the following day.

Lepus tolai lehmanni Severtzoff

Turkestan Hare

Lepus Lehmanni SEVERTZOFF, 1876, Ann. Mag. Nat. Hist., (4) XVIII, p. 169.

Two specimens: Tuz Bulak, one hundred and fifty miles north of Kizil Orda (Perovsk), Kazakstan.

A small pale-colored hare with tail broadly blackish on upper side. Skull relatively long and slender with narrow palate.

Color of two specimens from Tuz Bulak, taken on October 15 and 22: upper parts about smoke-gray; the hairs with a broad band of light buff, tipped with smoke-gray on flanks and hips and more blackish on mid-dorsal area and crown of head; shoulder and sides of head more buffy; ears in front evenly mixed buff and black with a creamy white border in front and a narrow black edge on terminal half of back, expanding at tip, posterior border and inside of ears light buff; tail white, with a broad black band on dorsal surface; upper side of fore and hind limbs and feet buff or white; under side of neck and breast to front legs buff mixed with gray; under parts, including under side of fore and hind limbs, throat, and chin, white. Summer pelage duller and browner, the buffy band on the hairs darker and the black tips less pronounced.

Measurements of two adult males: total length, 510, 545 mm.; tail vertebrae, 111, 90 mm.; hind foot, 125, 120 mm.; ear from notch, in dried skin, 80 mm. Skull: greatest length, 83, 82.5 mm.; zygomatic breadth, 41, 40 mm.; interorbital breadth in front of supraorbital process, 16, 15 mm.; behind supraorbital process, 12, 12.5 mm.; width of palate outside molars, 13.5, 13.3 mm.; length of nasals, 34.9, 33.9 mm.; alveolar length of upper molar series, 16, 15 mm.

This is a well-marked subspecies, characterized by its peculiar color and narrow skull. I found it not uncommon in the low sagebrush areas on the steppes of Kazakstan.

Saiga tatarica (Linnaeus)

Capra tatarica LINNAEUS, 1766, 'Syst. Nat.,' 1, p. 97.

Six specimens from Kirghiz Steppes, two hundred and fifty miles north of Kizil Orda (Perovsk) Kazakstan, Central Asia, altitude 1500 feet.

The saiga is a rather small, light-colored antelope; adults stand a little over two feet at the shoulders. It is readily distinguished from all other forms of antelope by its large inflated nose.

Color of an adult male taken in October, 1929: upper parts cinnamon-buff shading into pinkish buff on sides of body; nose and sides of face and outside of ears like back, inside of ears buffy white; crown of head from between eyes to neck hairs long and grizzled, nearly white and mixed with a few brownish hairs in front of ears; an irregular patch of short brownish hairs in front of eyes; tail above like back, white below; a white patch on rump around tail broken by a narrow strip of buff from back to tail; fore and hind limbs cinnamon-buff; under parts, including throat, chin, lips, and inner side of fore limbs to knees white; a narrow

strip of rather long dark hairs on mid-dorsal line above rump. An adult female has the whole front of the face and nose soiled whitish and the white of under parts extends in a narrow line down the inner side of fore and hind limbs. The white rump patch is more pronounced and not distinctly broken by a mid-dorsal line. Immature specimens similar to adult, but color a shade paler and with the grizzled patch on crown of head. In winter, pelage is reported to be almost pure white. The series taken in October had moderately long hair, which did not look as though it would be shed that fall.

Only the males have horns, which attain a length of 13 or 14 inches and are a peculiar translucent pale amber color. The horns of the adult male taken by the expedition are $11\frac{1}{2}$ inches long and have a spread of $7\frac{1}{2}$ inches. The weight of this specimen, before cleaning, was 100 pounds and an adult female weighed 80 pounds.

Saiga frequent the dry steppe country and especially the great flats of dried mud, common in the region visited; their food consists mainly of the long shoots that grow from a low sagelike plant and, according to the natives, they also eat a plant that looks like dried moss. Little information concerning their habits could be obtained from the natives; they are seldom seen, in the region visited, in herds that number over five or six, but it is possible that in sections where they are more abundant they travel in larger herds. It is evident that they migrate to some extent with the season, moving from the higher plateaus into the less snowy areas of the steppes in the fall. They move with a shambling, rather sneaking gait and carry their heads down whether at a walk, trot, or gallop, and apparently can easily outrun a horse.

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ON A PAREIASAURIAN REPTILE FROM SOUTH AFRICA,
*BRADYSAURUS WHAITSII*BY LIEUWE D. BOONSTRA¹

In 1914, Broom figured (Amer. Mus. Journ., XIV, p. 138) the skull and mandible of a pareiasaurian reptile, to which he gave the name, *Pareiasaurus whaitsii*.

In 1915, Broom published the same photograph together with a brief description (Bull. Amer. Mus. Nat. Hist., XXV, Pt. II, p. 109). The only important point in Broom's diagnosis was his statement that there were two horn-like processes on the ventral border of the lower jaw.

In 1929, Haughton and Boonstra accepted Broom's statement of the presence of two angular bosses and, as no other nearly related pareiasaur possessed two similar angular bosses, we created the new genus, *Bradysuchus*.

In 1933, I gave the following account of this specimen. "As I have not had the opportunity of seeing the type specimen in the American Museum of Natural History, this diagnosis had to be based on photographs kindly supplied by that institution and also on information received from Dr. R. Broom.

"The skull of the single specimen of this form is large; the teeth are badly preserved, but there were probably about 16 teeth with few (less than 9) cusps, probably arranged as in the genus *Bradysaurus*; the interorbital width is appreciably less than the 'tabular width'. The posterior border of the 'check' carries well-defined bosses. In general the skull is ornamented with pits and rugae. The maxilla and lacrymal are only slightly bulging. Both behind and in front of the orbit the dorsal and lateral surfaces are separated by a strong ridge. Medially the pterygoids are fused far posteriorly to form a long palate. The quadrate is inclined forwards. The brain-case and the supraoccipital pillar appear to be high. The tabular boss is prominent.

"Except for Broom's statement that the lower jaw carries two bosses on the angular, and the fact that the snout appears to be somewhat pointed, this genus is very similar indeed to the forms included in the genus *Bradysaurus*, particularly to *Br. seeleyi*."

¹Curator of the Palaeontological Collections, South African Museum, Cape Town.

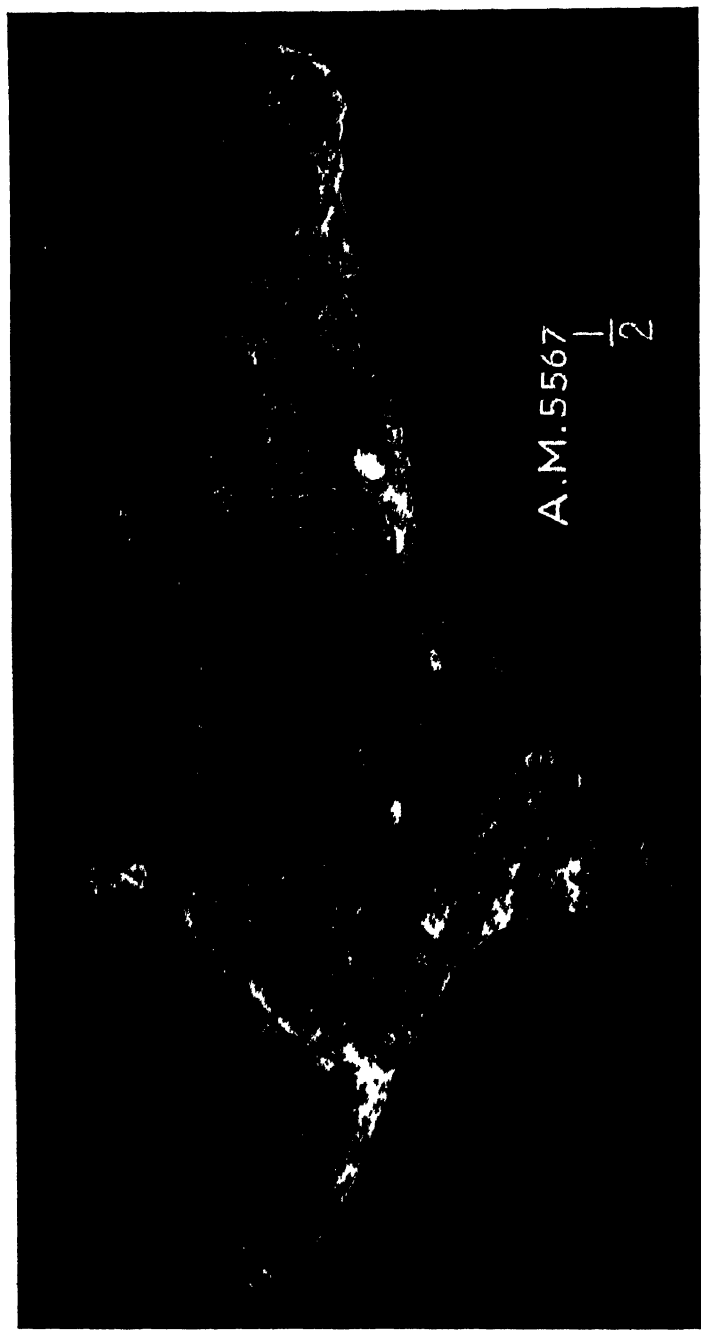


Fig. 1. *Bradysaurus whaitsi*. Type. Amer. Mus. No. 5567. Outer view of the right mandible, taken slightly from below to show the angular bosses. $\times \frac{1}{2}$.

I have now had the opportunity of examining the skull and lower jaws and find that my 1933 account is substantially correct—the only error being the acceptance of Broom's statement as to the presence of two normal angular bosses.

I publish here (Fig. 1) a photograph of the outer surface of the right mandible, which clearly shows the true nature of the protuberances on the angular. On the ventral border of the angular there is a large process, shaped roughly like a bovine teat; this process lies in nearly the same position and is of the same nature as in all the larger pareiasaurian species, but differs from that in the smaller species—*Anthodon*, *Koalemasaurus* and *Propappus omocratus*. Immediately above this process and on the level of the lower mandibular border, a deep groove separates the process from the general outer mandibular surface. Immediately above the anterior half of this groove, a large irregular boss is developed. These structures were interpreted by Broom as the normal condition in this pareiasaur, and on them he based his specific diagnosis.

I believe, however, that the development of the upper boss is not normal, but that it really represents a pathological growth. My interpretation is as follows:—the true angular boss is directed more medially than in *Bradysaurus*, *Nochelesaurus*, *Embriothosaurus*, *Dolichopareia*, *Pareiasuchus* and *Pareiasaurus*; this is due to the fact that the boss was fractured during the life of the animal and forced inward; the groove on the outer surface, above the process, represents the open fracture; in the process of healing, proliferation of bony tissues commenced, but, instead of closing up the fracture, produced the irregular mass of bony tissue dorsal to the fracture. I have shown the specimen to Dr. W. Granger, Dr. G. G. Simpson and Mr. E. H. Colbert, and they confirm my interpretation of the pathological nature of the dorsal boss.

Unfortunately, the greater part of the angular is missing on the left mandible.

If this interpretation of the angular bosses of this specimen is accepted, the character on which the genus *Bradysuchus* was created becomes invalid and this skull must be accepted as a representative of the genus *Bradysaurus*.

In 1933, I pointed out that this skull was very similar to that of *Bradysaurus seeleyi*, but that the snout was somewhat more pointed. The accompanying table of the chief skull measurements shows that this specimen, in comparison with *Bradysaurus seeleyi*, has a more pointed snout, a relatively larger and narrower palate, a smaller spread of the "cheeks," as well as a number of other differences in proportions. This

skull thus represents a fourth species of the genus *Bradysaurus*—*Bradysaurus whaitsi*.

CHIEF MEASUREMENTS

	<i>Bradysaurus whaitsi</i>	<i>Bradysaurus sealeyi</i>
Premaxilla to basioccipital . .	400 mm.	420 mm.
Pineal foramen to premaxilla. . .	260	275
Pineal foramen to postparietal	100	125
Width across the "cheeks". .	395	445
Intertabular width . .	195	195
Interorbital width . .	180	195
Premaxilla to front of orbit. .	165	185
Tabular boss to angle of "check" .	260	335
Width across last teeth	250	320
Prevomer to interpterygoid vacuity	275	250
Interquadrate width	260	345
Length of dentigerous border . . .	215	205
Number of teeth	16 or 17	16

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ON SOME SOUTH AFRICAN REPTILES OF THE SUBORDER THEROCEPHALIA PRESERVED IN THE AMERICAN MUSEUM OF NATURAL HISTORY

BY LIEUWE D. BOONSTRA¹

In the Department of Vertebrate Palaeontology of The American Museum of Natural History there is a small collection of the remains of thirteen therocephalian reptiles, which were purchased from Dr. R. Broom in 1913. Only two of these specimens are represented by fairly good skulls; all the others are fragmentary and consist chiefly of weathered snouts, which show some features of the dentition.

All these forms are from the Lower Beaufort Beds; six genera are from the *Tapinocephalus* zone, four from the *Endothiodon* zone, and one presumably comes from the base of the *Cistecephalus* zone.

Three families of the suborder Therocephalia are represented; these are:—one genus of the *Ictidosuchidae*, two genera of the *Scalopsauridae* and eight from the composite family *Pristerognathidae*.

Family PRISTEROGNATHIDAE

Alopecodon priscus Broom

BROOM, R., 1908, Ann. So. Afr. Mus., p. 361.

BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 64.

BOONSTRA, L. D., 1933, Ann. So. Afr. Mus., p. 216.

REFERRED SPECIMEN.—Amer. Mus. No. 5569, Fraserburg Road, Prince Albert District; *Tapinocephalus* zone.

This specimen is a very badly weathered fragment, which shows only some features of the dentition. There are remains of a total of fifteen incisors, with a space for an additional tooth between two teeth on the left premaxilla; there thus appear to be eight incisors on each side; the two posterior teeth differ somewhat in direction from the anterior ones and may represent two small canines; the posterior incisors are smaller than the anterior ones. The canine is of medium size. Remains of six small molars are preserved. In the lower jaw, the roots of one canine and three incisors are visible in the left dentary. The dental formula in

¹Curator of the Palaeontological Collections, South African Museum, Cape Town.

this specimen would thus be, $\frac{I-8, C-1, M-6?}{I-3, C-1, M-2?}$; for the type specimen in the South African Museum, Broom gave the formula, $\frac{I-7, C-2+1, M-4?}{I-2, C-2, M-2?}$.

The number of teeth is thus not identical in the two specimens and the question arises as to whether this specimen can rightly be referred to *Alopecodon priscus*. I have, however, recently pointed out how bad the types of the various reputed species of *Alopecodon* are, and, in view of this, it is perhaps best to include this form in the original species *Alopecodon priscus*.

***Alopecognathus angusticeps* Broom**

(Figures 1 and 2)

BROOM, R., 1915, Bull. Amer. Mus. Nat. Hist., XXV, Pt. II, p. 116.

BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 56.

TYPE.—Amer. Mus. No. 5559, Grootfontein, Beaufort West District; *Tapinocephalus* zone.

In 1915, Broom gave the dental formula, I-6, C-1, M-6, but he figured five incisors and seven molars; in 1932, he figured and described the formula as, I-6, C-1, M-8. I have ground down the left maxillary edge in order to expose the molars; there is now evidence of the existence of only five fairly small molars; behind the second molar there is a tip of a replacing tooth; the first molar lies 12 mm. posterior to the canine; the length of the series of five molars is 31 mm. On the right side, the crowns of four subequal molars are visible; anterior to the last tooth there is, however, a gap for another tooth, which would bring the total up to five. The canines are of medium size and have an oval cross-section. There are six subequal incisors, with a space of 12 mm. between the last incisor and the canine. The dental formula is thus, $\frac{I-6, C-1, M-5}{I-2, C-2, M-2?}$.

This type specimen consists of a practically complete skull, but, being preserved in a very intractable matrix, it has not been found possible to expose the occiput and palate; and it was only after a long process of grinding and etching that some features of the dorsal and lateral surfaces were determined. The skull is slightly crushed from side to side, but, even after this is corrected, it still remains a very long and narrow skull. The orbit is relatively small and is situated in the posterior half of the skull; the snout is thus very long. The temporal opening is relatively large and the narrow parietal crest fairly high.

The maxilla is large and, dorsally, stretches very nearly to the median line. The septomaxilla is fairly small, particularly that part lying posteriorly to the septomaxillary foramen. The prefrontal is large

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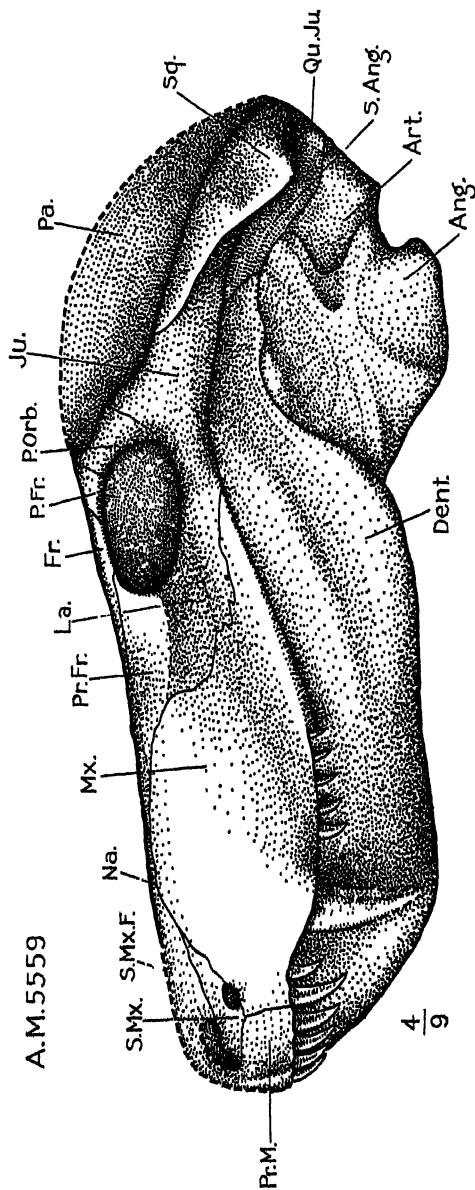


Fig. 1. *Alopocognathus angusticeps*. Lateral view of the type skull, Amer. Mus. No. 5559. $\times \frac{4}{9}$.

Ang. = angular.
Art. = articular.
B.Oc. = basioccipital.
Dent. = dentary.
Ect.Pter. = ectopterygoid.
Fr. = frontal.
I. = upper incisors.
I.P.V. = interpterygoid vacuity.
Ju. = jugal.
La. = lacrimal.
L.C. = lower canine.
Mx. = maxilla.
Na. = nasal.
Pa. = parietal.

Pal. = palatine.
P.Fr. = postfrontal.
P.Orb. = postorbital.
Pr.Fr. = prefrontal.
Pr.Ax. = premaxilla.
Pr.V. = prevomer.
Pter. = pterygoid.
Qu.Ju. = quadratojugal.
S.Mx. = septomaxilla.
S.Mx.F. = septomaxillary foramen.
Sq. = squamosal.
Sur.Ang. = surangular.
U.C. = upper canines.

and forms a rather prominent preorbital thickening, which overhangs a preorbital depression, whose surface is formed by the lacrymal. The nasals are very long but narrow; anteriorly and posteriorly they swell

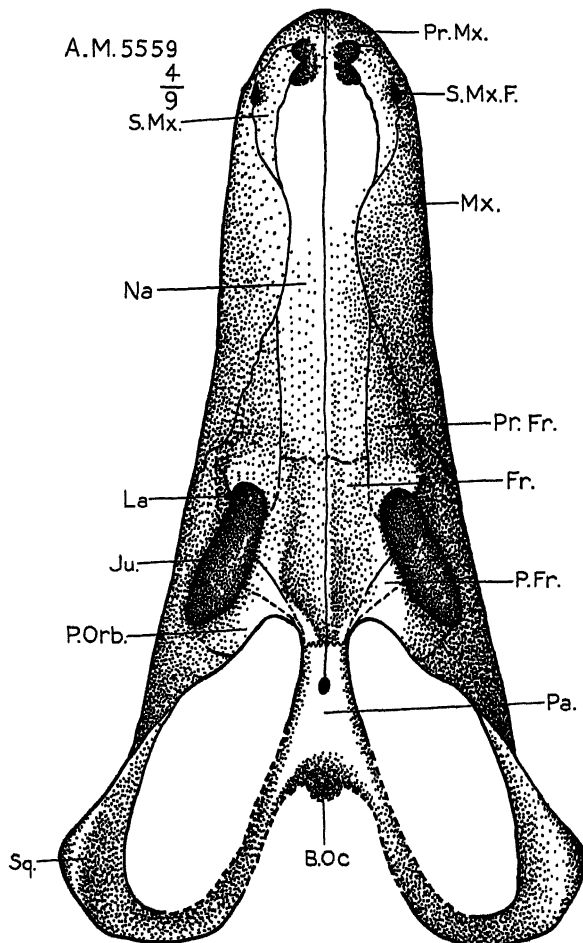


Fig. 2. *Alopecognathus angusticeps*. Dorsal view of the type skull, Amer. Mus. No. 5559. $\times \frac{4}{3}$.

out somewhat. The frontals are short and together present a cruciform dorsal surface; they enter the orbital border. Due to the nature of the matrix, it has not been possible to determine the limits of the postfrontal and postorbital; the postfrontal can, however, be only a small element.

The mandibular symphysis slopes sharply backwards; the outer surface of the angular is large and carries a number of ridges, which form the distinctive pattern met with in practically all therocephalians. The relations of the articular, quadrate and quadratojugal appear to be as in *Scymnosaurus watsoni*.

The long snout, high parietal crest, few molar teeth, and the details of the arrangement of the bones of the lateral and dorsal surfaces indicate that *Alopecognathus* is undoubtedly closely related with the generalized pristerognathid therocephalians, *Scymnosaurus* and *Pristerognathus*.

The chief skull measurements are:

Premaxilla to pineal foramen.....	210 mm.
Premaxilla to the anterior orbital border.....	140
Length of the lower jaw.....	240
Width across the squamosals.....	135?
Interorbital width.....	35
Intertemporal width.....	10
Width of the snout over the canines.....	55
Height of the snout at the canines.....	50

Alopecorhinus parvidens Broom

BROOM, R., 1912, Proc. Zool. Soc., p. 864.

BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 57.

TYPE.—Amer. Mus. No. 5503, Beaufort West Commonage; *Endothiodon* zone.

This type consists of a very fragmentary part of the snout; the left dentary is nearly complete; the symphyseal portion of the right dentary and parts of the two maxillae are also present. On the right side, remains of three small incisors are visible; there appears to be space for a total of six; the canine is of medium size and is rounded in section; a diastema is followed by the remains of the crowns of seven small molars. There are four lower incisors, the fourth lying interior to the line of the other three; the lower canine is small and is rounded in section.

Broom's (1932) reconstruction of the left side is poor; the lower border of the dentary curves evenly upwards in the direction of the coronoid process; behind the canine the maxilla is concave; the mandibular symphysis is long and low; the snout was presumably broad and low. The dental formula is $\frac{1-0?}{1-4}, \frac{C-1}{C-1}, \frac{M-7}{M-7}$.

As this specimen shows little more than some features of the teeth, it appears unlikely that it will ever be possible to identify new finds as definitely of this species. Thus the "species" is simply another name which encumbers scientific literature, without adding to our knowledge of the Therocephalia.

***Cynariognathus platyrhinus* Broom**

BROOM, R., 1912, Proc. Zool. Soc., p. 863.

BROOM, R., 1915, Phil. Trans. Roy. Soc. London, p. 47.

BROOM, R., 1931, Rec. Albany Mus., p. 161.

BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 57.

BOONSTRA, L. D., 1934, Ann. So. Afr. Mus., p. 216.

TYPE.—Amer. Mus. No. 5502, Grootfontein, Beaufort West District; *Tapinocephalus* zone.

This type consists of an incomplete, weathered snout; it is of a medium-sized skull; the snout is low and broad; the relations of the septomaxilla and septomaxillary foramen are correctly figured by Broom (1932). In the upper jaw, roots of three incisors are preserved on the right side; there is sufficient space for an additional two. On the left side there are roots of three incisors, a fragment of one anterior to these and a space for another. There thus appear to be five incisors in each premaxilla; the incisors increase in size in anterior direction, so that there would not be space for a total of six as maintained by Broom; on the right side the last incisor but one has a posterior edge, which may be serrated. The upper canines are fairly large and are rounded in section; no evidence of serrations is preserved. Remains of eight molars are preserved in the left maxilla; they are close-set and decrease in size in posterior direction; no evidence of serrations is preserved. In the lower jaw, the incisors are hidden by the upper jaw; in the right dentary, one canine, followed, without diastema, by remains of eight molars, is visible. The dental formula is thus: $\frac{I-9, C-1, M-8}{I-7, C-1, M-8}$. Of the palate, nothing can be determined with any degree of certainty. The specimen in the British Museum (No. R4097) recently redescribed by me appears, in the light of the above facts, to be correctly identified as of this species.

***"Ictidosaurus angusticeps"* Broom**

BROOM, R., 1903, Ann. So. Afr. Mus., p. 151.

BROOM, R., 1915, Bull. Amer. Mus. Nat. Hist., XXV, Pt. II, p. 118.

BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 60.

REFERRED SPECIMEN.—Amer. Mus. No. 5527, Beaufort West; *Endothiodon* zone.

This laterally crushed snout shows the following characters: a deep square mandibular symphysis; in the upper jaw, the roots of seven molars, visible on both sides; one very long slender canine; four fair-sized incisors on both sides, with posteriorly an additional small tooth, which appears to be implanted in the premaxilla; in the lower jaw, four incisors in both dentaries. The dental formula is thus: $\frac{I-4 \text{ or } 5, C-1, M-7}{I-4, C-1, M-7}$; for

the type Broom gave the formula: $\frac{I-5+1}{I-1}, \frac{C-1+1}{C-1}, \frac{M-8}{M-4}$. If the nature of the dentition alone constitutes a valid criterion, then this specimen cannot be included in the species *Ictidosaurus angusticeps*. It is, in fact, doubtful if this snout is that of a therocephalian at all; the square mentum suggests that it is a gorgonopsian, but, with the exception of *Lycaenodon longiceps*, no gorgonopsian has so large a number of molars. I regard this fragment as unidentifiable and do not propose to distinguish it by a new name from *Ictidosaurus angusticeps*.

Scylacoides ferox Broom

BROOM, R., 1915, Bull. Amer. Mus. Nat. Hist., XXV, Pl. II, p. 119.

BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 57.

TYPE.—Amer. Mus. No. 5558, Beaufort West; ?*Tapinocephalus* zone.

This type consists of a crushed snout, without the dentaries; the left side is imperfectly preserved, and Broom's figure (1932) is probably a fairly correct reconstruction. On grinding down the dentigerous border, the teeth roots were rendered visible; five small uncrowded incisors are present on both sides; the single canine on each side is fairly large and is oval in cross-section; the roots of five small molars are visible. The dental formula is thus: I-5, C-1, M-5. The palate is badly stripped, so that no details of its structure can be determined with certainty; there appears to be no suborbital vacuity; it appears probable that the pre-molars underlie the palatines. The former fact would point to this form being a gorgonopsian; the latter, to its being a therocephalian. No other diagnostic characters can be determined, so that it is impossible to state in which of these suborders this snout belongs. That one cannot even determine the suborder again stresses the absolute futility of creating new so-called "species" on such bad material.

Scylacosaurus sclateri Broom

(Figure 3)

BROOM, R., 1915, Bull. Amer. Mus. Nat. Hist., XXV, Pt. II, p. 120.

BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 62.

BOONSTRA, L. D., 1934, Ann. So. Afr. Mus., p. 219.

REFERRED SPECIMEN.—Amer. Mus. No. 5560, Beaufort West; ?*Tapinocephalus* zone.

This specimen was first described by Broom under the name *Scylacorhinus falkenbachii*. It consists of the anterior half of a skull from which most of the dorsal surface has been weathered away. The teeth are, however, clearly shown. The dental formula is as given by Broom, I-7, C-1+1, M-8. Anterior to the large canine, there are thus eight teeth,

as in *Scylacosaurus*; in describing the skull of *Scylacosaurus* in the British Museum, I thought that the posterior three precanine teeth were probably implanted in the maxilla, but the evidence was not very conclusive, due to the amount of overlap of the maxilla over the premaxilla; whether these posterior precanine teeth are canines or incisors must, I

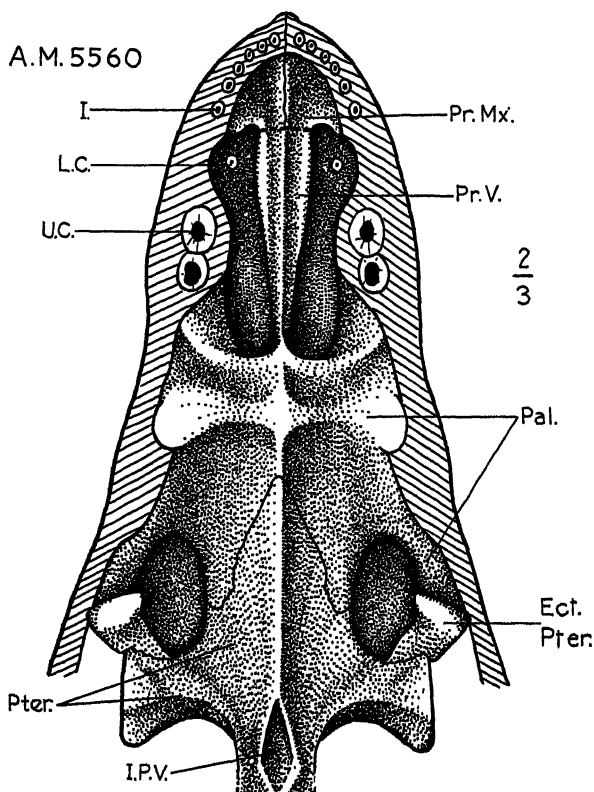


Fig 3. *Scylacosaurus sclateri*. Dorsal view of the anterior two-thirds of the palate, Amer. Mus. No. 5560. $\times \frac{2}{3}$.

think, remain uncertain, and therefore the slight differences in the arrangement of these teeth in these two forms should not be taken to imply generic differences. In all other characters—general form, size, nature of the maxillaries, dentaries and the mandibular symphysis, the dentigerous ridges on the pterygoids and the details of the palatal structure, as described below—the two skulls are in close agreement. I

propose, therefore, that the name *Scylacorhinus falkenbachii* be considered a synonym of *Scylacosaurus sclateri*.

I have been able to expose the dorsal surface of the palate (Fig. 3); this is the first time that this structure can be studied from this view in any therocephalian. The anterior two-thirds of the palate is formed by the usual four elements—paired prevomers, palatines, ectopterygoids and pterygoids. The prevomers have the usual spatulate shape; their posterior ends underlie the palatines; on their dorsal surface a thin, but high, median keel is developed; this is confluent with a median ridge on the palatines. In dorsal view, the palatine shows a very interesting structure; its posterior two-thirds is represented by a thin sheet of bone, whose median and posterior edges overlie the prevomer and pterygoid, and form the antero-medial edge of the large suborbital foramen; the important feature, however, is situated on the anterior third; here two thickened ridges form two transverse girders, medially confluent with the median longitudinal ridge and laterally abutting against the maxilla.

The median ridge and these transverse girders are of interest when considering the palatal structure from an architectural point of view, viz., the whole of the primary palate is, in general, formed by thin sheet-like bones; these sheets of bone produce a lightening of the skull, but any resultant weakening is counteracted by the development of a system of girders admirably adapted for withstanding all the strains and stresses to which the palate is subjected. The pterygoid is also, in general, a sheet-like bone, but it likewise has a median dorsal ridge and a thickened lateral flange. A slit-like interpterygoidal vacuity separates the pterygoids at the level of the transverse flanges. The ectopterygoid is a V-shaped bone forming the lateral and part of the posterior border of the suborbital vacuity. The V-shape seems to be developed for mechanical reasons; with this aspect in view, it is interesting to note that the anterior limb of the ectopterygoid is overlain by a beam of the palatine, and that the other limb presses downward on the corner of the transverse pterygoidal flange; the ectopterygoid is thus locked and perfectly adapted to withstand any pressure tending to force the lateral pterygoidal flange upwards.

***Trochosaurus major* Broom**

BROOM, R., 1915, Bull. Amer. Mus. Nat. Hist., XXV, Pt. II, p. 121.

BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 50.

BOONSTRA, L. D., 1934, Ann. So. Afr. Mus., p. 227.

TYPE.—Amer. Mus. No. 5543, Rietfontein, Prince Albert District; *Tapinocephalus* zone.

The type consists of a weathered and laterally compressed anterior two-thirds of a skull; much of the surface bone is weathered away, but on the right side some points of structure can be determined; the nasal is broader anteriorly than posteriorly; together the two frontals form a large cruciform bony surface, with a small entry on to the orbital border; the prefrontal and lacrymal are large; the maxilla is fairly deep.

The teeth are badly preserved; remnants of five incisors, with serrations, are preserved; on the left side, two erupted canines are visible; on the right, only one is erupted, but in the maxilla the root of another can be seen; in the right maxilla, two definite molar roots are visible, with an indefinite indication of another root. On the left dentary, four molars are visible and there appear to be three incisors. The dental formula is thus: $\frac{I-5, C-1 \text{ or } 2, M-2 \text{ or } 3}{I-3, C-0, M-4?}$.

A full description of the dorsal, lateral, occipital and palatal surfaces, together with the outer view of the brain-case, of a specimen of this species in the British Museum has recently been given by me.

Family ICTIDOSUCHIDAE

Ictidosuchus primaevus Broom

BROOM, R., 1900, Ann. Mag. Nat. Hist., p. 314.

BROOM, R., 1901, Trans. So. Afr. Phil. Soc., p. 177.

BROOM, R., 1912, Anat. Anz., p. 628.

BROOM, R., 1915, Bull. Amer. Mus. Nat. Hist., XXV, Pt. II, p. 119.

BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 77.

TYPE.—Amer. Mus. No. 5529, Near Pearston, Cape Colony; *Enlothiodon?* zone.

The material is very badly preserved; there is a right dentary with parts of seven teeth; in the maxilla the molar roots are very indistinct; four are distinct, but there may have been a total of seven or eight; the skull is broad over the squamosals, but the snout is narrow; the temporal openings are large; the orbits are medium-sized; there is a deep preorbital depression; the frontals are cruciform.

The left scapulo-coracoid is well preserved, except that the upper part of the scapular blade cannot be seen; Broom's original figure (1901) is very accurate.

The limb-bones are very fragmentary; the large entepicondylar foramen of the humerus is noteworthy; the shaft is long and slender.

Family **SCALOPOSAURIDAE****Ictidognathus parvidens** Broom

BROOM, R., 1911, Proc. Zool. Soc., p. 1078.

BROOM, R., 1914, Phil. Trans. Roy. Soc., London, p. 47.

WATSON, D. M. S., 1931, Proc. Zool. Soc., p. 1186.

BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 72.

TYPE.—Amer. Mus. No. 5522, Kuilsport Nek; *Cistecephalus* zone.

In 1911, Broom gave the dental formula, $\overset{I-6, C-2, M-10}{I-6? \text{ or } 7, C-2, M-11?}$; in 1932, Broom gave the formula, $\overset{I-6?, C-2, M-9+3?}{I-4?, C-1, M-12}$. I find the formula to be: $\overset{I-6?, C-2, M-9+3?}{I-4?, C-1, M-12}$. After grinding, the roots of the teeth in the left dentary, of the right maxillary molars and of the left canines, became visible. The two canines in the left maxilla are of nearly equal size; in the right maxilla, the posterior one is large and the anterior one small. Posterior to the canines on the left side, there is a diastema followed by the roots of nine molars—the maxilla is then broken off. In the premaxilla, there is room for at least five incisors, but there may have been six. The mandibular molars follow immediately on the canine; this canine is smaller than either of the maxillary canines. The nine upper molars occupy a distance of 15 mm.; the twelve lower molars occupy 21 mm.

Very little of the snout structure can be determined; the septomaxilla is long and its foramen large. The snout is bulbous; posteriorly to this swelling, the surface is scooped out dorsally and laterally and then rises to form two prominent bosses on the prefrontal. The swollen nature of the snout of *Ictidognathus* is the only character wherein it resembles *Scaloposaurus*, where the maxillaries flare out anteriorly. Watson has already pointed out that, in its dentition, this form differs from *Scaloposaurus*, and, if it were not for the shape of the snout, I would agree with Watson that "there appears to be no sound reason for regarding this animal as a Scaloposaurid."

Ictidostoma (Ictidognathus) hamburyi Broom

BROOM, R., 1912, Proc. Zool. Soc., p. 865.

BROOM, R., 1914, Phil. Trans. Roy. Soc. London, p. 47.

BROOM, R., 1915, Bull. Amer. Mus. Nat. Hist., XXV, Pt. II, p. 117.

BROOM, R., 1930, Phil. Trans. Roy. Soc. London, p. 371.

BROOM, R., 1931, Rec. Albany Mus., p. 161.

WATSON, D. M. S., 1931, Proc. Zool. Soc., p. 1186.

BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 72.

TYPE.—Amer. Mus. No. 5520, Beaufort West; *Endothiodon* zone.

This snout only shows some features of the dentition; there are five subequal incisors; the main canine is fairly small; immediately in front

of the canine there lies a very small tooth; the portion of the left maxilla preserved shows the roots of eight small molars; in the right maxilla, ten molar roots and a set of replacing teeth are visible. The dental formula thus is, I-5, C-1+1, M-10.

Topotype, Amer. Mus. No. 5521, Beaufort West; *Endothiodon* zone.

In this snout there are six small, long and slender incisors on either side; the canines are long and slender and rounded in cross-section; immediately anterior to these, there is a small tooth on either side; in the right maxilla, grinding has revealed only the roots of five molars. In the lower jaw, grinding has revealed four incisors, one canine and nine molars; the dental formula thus is: $\frac{I-6, C-1+1, M-5+?}{I-4, C-1, M-9+?}$.

These two specimens again show only some features of the dentition. Amongst reptiles this is seldom a very reliable criterion. I doubt whether, in this case, it justifies distinguishing this form by name from *Ictidognathus*. In any case, it offers no conclusive testimony as to the affinities of this animal. For convenience, both *Ictidognathus* and *Ictidostoma* may provisionally be retained in the family Scaloposauridac, until their affinities are determined or until they prove indeterminable.

SUMMARY

1. A fairly good skull of the pristerognathid, *Alopecognathus angusticeps*, is figured in dorsal and lateral view and described; it is shown that this form is a fairly primitive therocephalian, related to *Pristerognathus* and *Scymnosaurus*.

2. In describing the palate of *Scylacosaurus sclateri*, I have drawn attention to the architectural arrangement of the constituent bones.

3. It is pointed out that there is very little evidence that *Ictidognathus* and *Ictidostoma* are scaloposaurids; this is in confirmation of Watson's opinion (1931).

In conclusion, my thanks are due to the officers of the Department of Vertebrate Palaeontology of The American Museum of Natural History for affording me the facilities I have enjoyed in my study of the material in their charge. To the University of Stellenbosch I am indebted for a small grant, which has enabled me to visit New York. The drawings which illustrate this paper have been done by my wife.

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ON THE SOUTH AFRICAN GORGONOPSIAN REPTILES
PRESERVED IN THE AMERICAN MUSEUM OF
NATURAL HISTORYBY LIEUWE D. BOONSTRA¹

On the whole, the gorgonopsians are much better represented in the Broom Collection than the therocephalians. There are seventeen specimens, which represent eight gorgonopsian genera. There are: one form from the *Tapinocephalus* zone, four from the *Endothiodon* zone and three from the *Cistecephalus* zone. There are eight fairly complete skulls, the best being a good skull, which is the second known specimen of Owen's original genus *Gorgonops*; one good lower jaw, which shows the whole structure of the gorgonopsian mandible; eight poor snouts and some parts of the postcranial skeleton in association with some of the skulls.

From the *Tapinocephalus* zone there is only one specimen.

***Eriphostoma microdon* Broom**

BROOM, R., 1911, Proc. Zool. Soc., p. 1078.

BROOM, R., 1915, Bull. Amer. Mus. Nat. Hist., XXV, Pt. II, p. 117.

BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 53.

TYPE.—Amer. Mus. No. 5524, Fraserburg Road; *Tapinocephalus* zone.

This specimen consists of two weathered portions of a fairly small skull (premaxilla to basioccipital—?110 mm.) and these are not in contact; the dorsal bones are weathered away; the greater part of both sides is also missing. The symphysis of the lower jaw is high and square; the snout is high, but narrow; the orbit appears to have been fairly small. In the right premaxilla, parts of the crowns of four incisors are preserved; on the third tooth a serrated posterior border is visible. One slender canine is, in part, preserved, and, immediately anterior to it is the tip of a replacing canine in the process of erupt on. On the right side the incisor series measures 11 mm.; the diastema, to the functional canine, measures 13 mm. On the left side the crown of one canine is seen; this is followed by a diastema of 11 mm.; posterior to the diastema, only the remains of two closely-set, slender molars are preserved. As the

¹Curator of the Palaeontological Collections, South African Museum, Cape Town

septomaxilla is not preserved, Broom's figure (1932) showing that element is hypothetical. Since the intertemporal region is lost, it is not possible to state with certainty whether *Eriphostoma* is a gorgonopsian or a therocephalian; the only evidence, which is not conclusive, that this form is a gorgonopsian is afforded by the nature of the mandibular symphysis; this is upright, whereas in the therocephalians it generally slants backwards.

From the *Endothiodon* zone there are specimens of four genera—*Gorgonops*, *Aelurosaurus*, *Aloposaurus* and *Scymnognathus*.

***Gorgonops torvus* Owen**

(Figures 1-3)

OWEN, R., 1876, Cat. Foss. Rept. So. Afr., p. 27.

WATSON, D. M. S., 1914, Proc. Zool. Soc., p. 1031.

BROOM, R., 1915, Bull. Amer. Mus. Nat. Hist., XXV, Pt. II, p. 126.

WATSON, D. M. S., 1921, Proc. Zool. Soc., p. 39.

BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 113.

BOONSTRA, L. D., 1934, Ann. So. Afr. Mus., p. 181.

REFERRED SPECIMEN.—Amer. Mus. No. 5515, Beaufort West; *Endothiodon* zone.

This specimen is a good skull, which lacks only the lower jaws and both quadrates and quadrato-jugals. It shows many more details of the cranial structure than does the type in the British Museum. In view of the full descriptions by Watson and myself based on the type, this account is purely supplementary.

After removing the bulk of the matrix with a chisel, a long process of alternately polishing and etching with dilute acid has revealed the majority of the sutures—some of them being beautifully shown.

On the dorsal surface the following features, not very well shown in the type, have been determined: the limits of the large preparietal are beautifully exposed; the distinctive parietal crests are shown in the accompanying figures; the infratemporal bar is preserved, and it is now certain that the temporal openings are of moderate size; in between the parietal crests, the occiput slopes gently backwards and downwards; the septomaxilla is large and its foramen opens into the posterior corner of a fairly large hollow.

In ventral view, the relations of the palatines, pterygoids and ectopterygoids are clearly exposed, and they show that my interpretation of their structure in the type was correct and my criticism of Watson's (1921) interpretation justified. The dentigerous ridges on the palatines and the pterygoids are very imperfectly preserved in the type; here they are well shown; these ridges differ from the condition shown in all

A.M. 5515

$\frac{2}{3}$

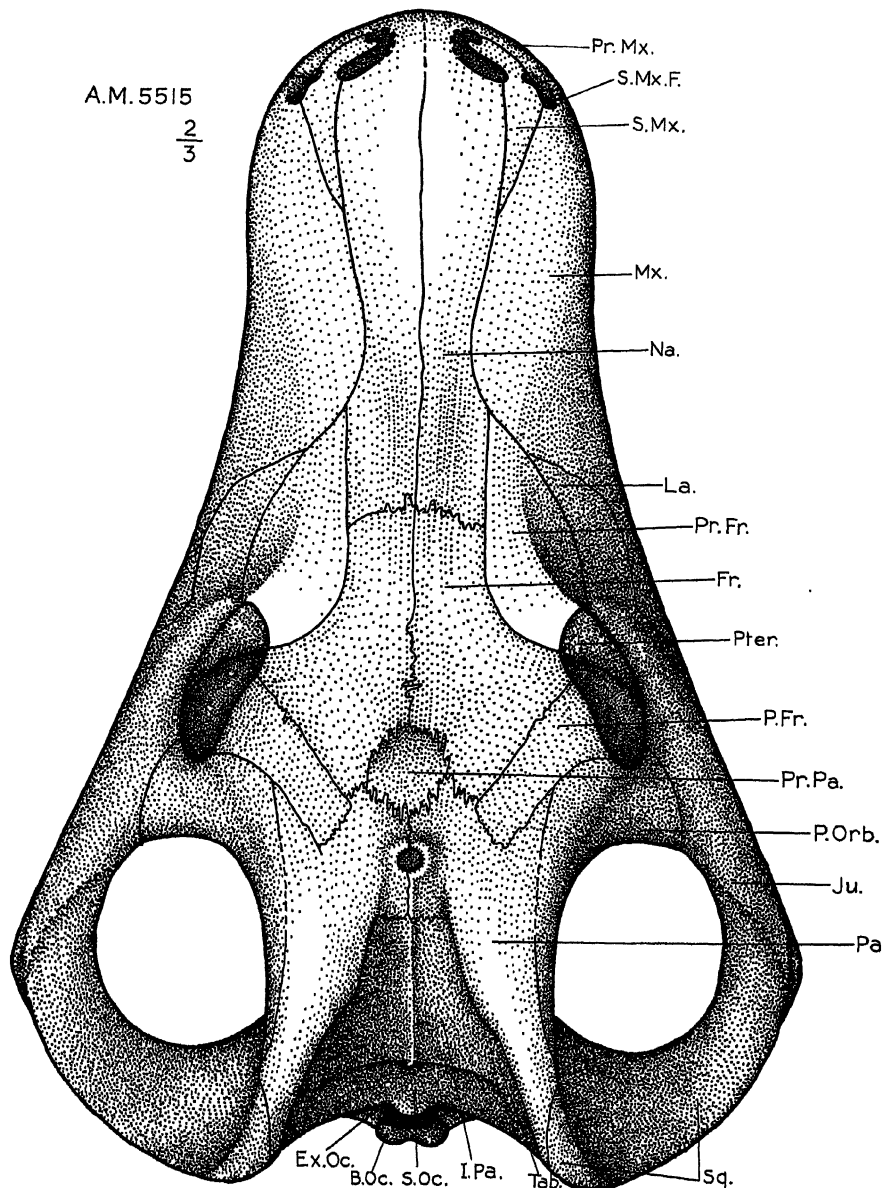


Fig. 1. *Gorgonops torvus*. Amer. Mus. No. 5515. $\times \frac{2}{3}$. Dorsal view of the skull.

B. Oc. = basioccipital.
Ex. Oc. = exoccipital.
Fr. = frontal.
I. Pa. = interparietal
Ju. = jugal.
La. = lacrymal.
Mx. = maxilla.
Na. = nasal.
Pa. = parietal
P. Fr. = postfrontal

P. Orb. = postorbital.
Pr. Fr. = prefrontal.
Pr. Mx. = premaxilla.
Pr. Pa. = preparietal.
Pter. = pterygoid.
S. Mx. = septomaxilla.
S. Mx. F. = septomaxillary foramen.
S. Oc. = supraoccipital.
Sq. = squamosal.
Tab. = tabular.

A.M. 5515

$\frac{2}{3}$

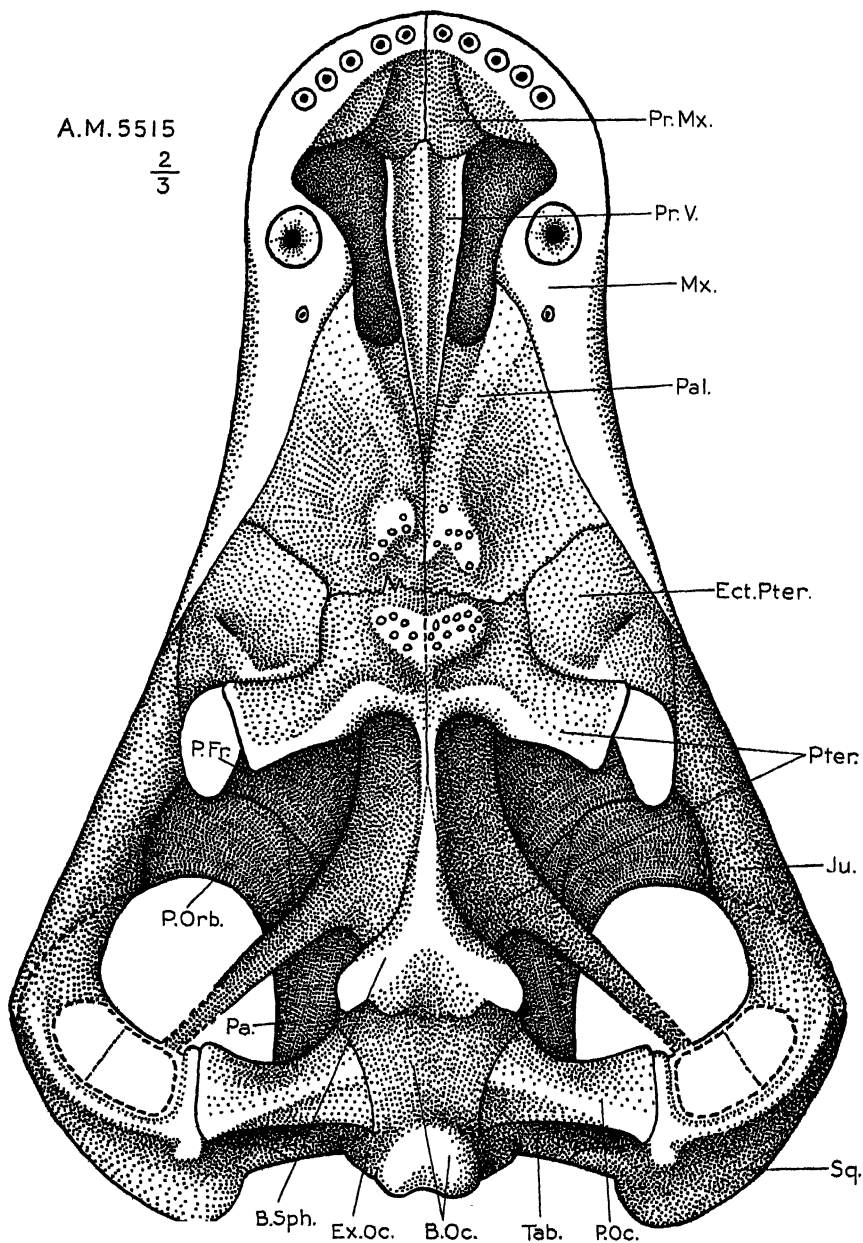


Fig. 2. *Gorgonops torvus*. Amer. Mus. No. 5515. $\times \frac{2}{3}$. Ventral view of the skull.

B.Sph. = basisphenoid.
 Ect.Pter. = ectopterygoid.
 Pal. = palatine.
 P.Oc. = paroccipital.
 Pr.V. = prevomer.
 Other lettering as in Fig. 1.

of the gorgonopsians that I have examined, in that the part on the pterygoid is widely separated from that on the palatine, and in their distinctive shape, as shown in the accompanying figure. Unfortunately, the basicranium had been damaged before fossilization commenced; the structures that can be determined are incorporated in the figure of the ventral surface of the skull.

As in the type, the root of only one small molar can be seen; *Gorgonops* has been considered to be a fairly primitive type of gorgonop-

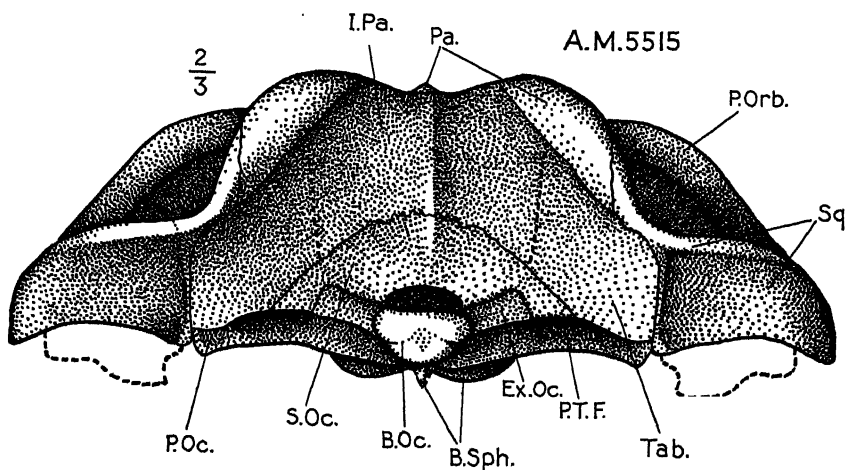


Fig. 3. *Gorgonops torvus*. Amer. Mus. No. 5515. $\times \frac{2}{3}$. Occipital view of the skull.

P.T.F. = posttemporal fenestra.
Other lettering as in Figs. 1 and 2.

sian; the reduction of the molars is a fact that can hardly be reconciled with this view; the specialized nature of the palatal dentigerous ridges is also a feature which one would not expect in a primitive gorgonopsian.

***Aelurosaurus felinus* Owen**

- OWEN, R., 1881, Quar. Journ. Geol. Soc., p. 261.
 LYDEKKER, R., 1890, Cat. Foss. Rept. Amph., p. 75.
 SEELEY, H. G., 1895, Phil. Trans. Roy. Soc. London, p. 991.
 BROOM, R., 1910, Trans. Roy. Soc. So. Afr., p. 23.
 BROOM, R., 1911, Proc. Zool. Soc., p. 1077.
 BROOM, R., 1912, Proc. Zool. Soc., p. 863.
 WATSON, D. M. S., 1921, Proc. Zool. Soc., p. 86.
 BROOM, R., 1931, Rec. Albany Mus., p. 165.
 BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 118.
 BOONSTRA, L. D., 1934, Ann. So. Afr. Mus., p. 189.

TYPE.—Amer. Mus. No. 5514. *Aelurosaurus breviceps*, Beaufort West, *Endothiodon* zone.

TYPE.—Amer. Mus. No. 5506. *Aelurosaurus striatidens*, Kuilspoor, *Endothiodon* zone.

TYPE.—Amer. Mus. No. 5504. *Aelurosaurus tenuirostris*, Kuilspoor, *Endothiodon* zone.

TYPE.—Amer. Mus. No. 5528. *Aelurosaurus whaitsi*, Beaufort West, *Endothiodon* zone.

REFERRED SPECIMEN.—Amer. Mus. No. 5607. ?*Aelurosaurus felinus*, Beaufort West, *Endothiodon* zone.

All these specimens consist of more or less imperfect snouts, which, I believe, show no valid characters which would distinguish them from Owen's original species. Amer. Mus. No. 5514 is a good anterior part of a small gorgonopsian skull, of which Broom has given a correct lateral view (1932). The dental formula is: I-5, C-1, M-4. All the characters shown are as in *A. felinus*; the fact that it represents a slightly larger animal is no justification, without corroborative evidence, for the creation of a distinct species.

Amer. Mus. No. 5506 is a bad small snout showing only some features of the dentition; on each premaxilla there are five incisors; in the maxilla, one long slender canine, oval in cross-section, the crowns of two and the roots of another two molars are present. The dental formula, I-5, C-1, M-4, is thus as in Owen's *A. felinus*. On the canine and incisors, however, vertical striae are preserved, and on all the teeth faint indications of serrations on the posterior borders are visible. In Owen's type, these striae have not been determined with certainty. Without some other supporting evidence, the smaller size of this animal and the striae on the teeth cannot be accepted as sufficient proof of specific distinction from *A. felinus*.

Amer. Mus. No. 5504 consists of a weathered, laterally compressed snout. On the right side, there are remnants of four incisors, the fifth being lost; one long canine, oval in cross-section; and the roots of two molars. On the left side, there are remains of five incisors, the fifth being small; one canine and no molars. As Broom himself suggested that some of the molars may be lost through old age, there are no characters present which would preclude this specimen being included in Owen's *Aelurosaurus felinus*.

Amer. Mus. No. 5528 consists of a fragment of the left premaxilla and maxilla, part of the right maxilla, a fragment of the symphyseal part of the right dentary and a little fragment of the roof of the skull.

In the dentary, the roots of one canine, oval in cross-section, and four closely packed incisors are visible; the symphysis is high and forms

a right angle with the ramus; no molars are preserved. In the left upper jaw there are: one canine, oval in cross-section and with its posterior edge serrated; the roots of five incisors; no molars are preserved.

In the topotype, Amer. Mus. No. 5513, a weathered snout shows that the dental formula is, I-5, C-1, M-5; all the teeth have serrated posterior borders.

The measurements of these two specimens are as for Owen's *A. felinus*, and, although there is one more molar, I think that we may well regard *A. waitisi* as a synonym of *A. felinus* until better preserved specimens prove the contrary.

In Amer. Mus. No. 5607 parts of a small skeleton have been referred by Broom to ?*Aelurosaurus felinus*. The right femur of this specimen has been figured by Williston and by Gregory under this name. In no case is there anything of the postcranial skeleton preserved in association with any skull of *Aelurosaurus*, and as this skeletal material is not associated with any identifiable cranial material, there is no evidence whatsoever that we are dealing with the genus *Aelurosaurus*. This specimen consists of the imperfect pelvis, which shows that the elements were loosely connected; the ilium has a posterior and an anterior expansion; the pubis has a long anterior process and a large pubic foramen; the ischium has a fairly long posterior extent; the acetabulum is large—the main part being formed by the ilium; there are two good femora, tibiae and fibulae; a fair left humerus, with its distal end, however, not in contact; the deltoid crest is fairly strong.

***Aloposaurus gracilis* Broom**

BROOM, R., 1910, Bull. Amer. Mus. Nat. Hist., XXVIII, Art. xx, p. 208.

BROOM, R., 1915, Bull. Amer. Mus. Nat. Hist., XXV, Pt. II, p. 124.

BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 126.

TYPE.—Amer. Mus. No. 5317, Kuilspoort; *Endothiodon* zone.

This specimen consists of a complete skull, which, however, has been badly crushed and fractured; the structure of the outer surface can, nevertheless, be determined. Broom's lateral view probably shows the true shape of the skull; his identification of some of the elements is at fault; a distinct postfrontal is present; the frontal has a long entry on to the supraorbital border; from the pineal foramen the occiput slopes gently to the condyle; the median keel of the basisphenoid is very deep and the tubera are laterally directed, but are rounded. In 1910, Broom gave the dental formula $\frac{I-5, C-1, M-7.5}{I-4, C-1, M-7}$, but he figured I-5, C-2, M-6; in 1915, the formula was, I-5, C-1, M-7.6 and, in 1932, I-5, C-1, M-6.

I find it to be $\frac{I-5, C-1, M-4+1?}{I-4, C-1, M?}$. There are vertical striae on the incisors; in the left maxilla, there is a replacing canine anterior to the functional one; the crowns of four small molars are preserved, but, posterior to the first, there is a space, which may have housed another tooth; in the right maxilla one canine root is visible, and, by grinding, four molar roots have been exposed; posterior to the first a space is again visible.

***Scymnognathus whaitsi* Broom**

BROOM, R., 1912, Proc. Zool. Soc., p. 861.

WATSON, D. M. S., 1921, Proc. Zool. Soc., p. 44.

BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 116.

BOONSTRA, L. D., 1934, Ann. So. Afr. Mus., p. 183.

TYPE.—Amer. Mus. No. 5530, Beaufort West Commonage; *Endothiodon* zone.

This genus was founded on three crushed and weathered skulls. The type specimen lacks the snout. The dental formula is, I-?, C-1, M-4. Watson's figures, based on a specimen in the British Museum, are more nearly correct than those of Broom; the precanine step in the dentigerous border is, however, not so pronounced as figured by Watson; the preparietal is long and oval as Watson figured it; the frontal-prefrontal suture, not figured by Watson, is as given by Broom.

In the topotype, Amer. Mus. No. 5531, the dental formula is, I-5, C-1, M-4; the relations of the septomaxilla and the structure of the occiput are as figured by Watson for the British Museum specimen.

In the other topotype, Amer. Mus. No. 5544, the large preparietal is well shown.

A specimen, Amer. Mus. No. 5563, shows a good atlas and axis, in which the atlantal arch, intercentrum and the greatly elongated axial spine are well shown.

In the collection there is also a weathered, though complete, humerus, which shows a large entepicondylar foramen; a snout, Amer. Mus. No. 5546, is unidentifiable, and of a large number of fragments of the postcranial skeleton very little can be determined.

From the *Cistecephalus* zone there are specimens of three genera preserved in the collection: *Delphaciognathus*, *Ictidorhinus* and *Lycaenoides*.

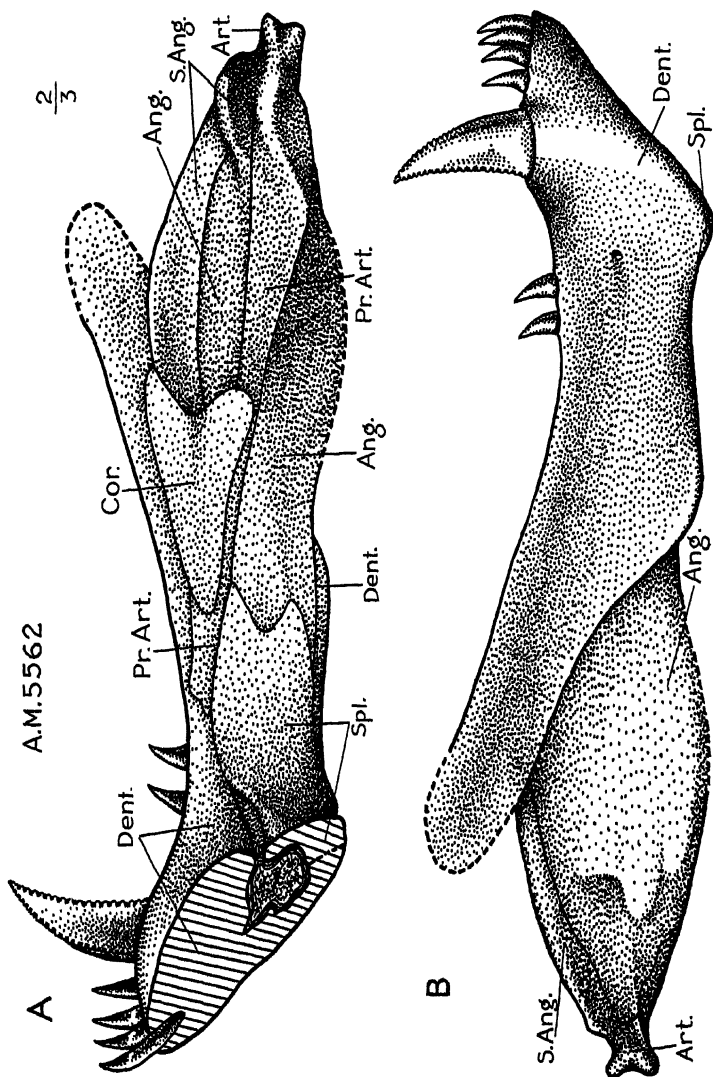
***Delphaciognathus paucidens* Broom**

(Figure 4)

BROOM, R., 1915, Bull. Amer. Mus. Nat. Hist., XXV, Pt. II, p. 125.

BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 126.

TYPE.—Amer. Mus. No. 5562, Wittekop, Nuweveld; *Cistecephalus* zone.



This species was founded by Broom on a well-preserved lower jaw, which consists of a complete right ramus and the anterior half of the left ramus. The only character mentioned by Broom to justify the creation of a new genus is the presence of two lower molars. As practically nothing is known of the lower molars of the majority of gorgonopsians, this single character seems to be a very insecure basis for generic distinction. In *Aelurognathus microdon* there are also two lower molars. A re-examination of the lower molars of the well established types will no doubt indicate the correct synonymy.

I have had the mandible cut through at the symphysis in order to determine the relations of the dentary and splenial and to be able to expose the anterior third of the inner surface of the jaw.

The splenial is a relatively small bone, forming the anterior third of the inner surface and the ventral corner of the mentum.

The dentary is large; it forms a strong, fairly upright symphysis, but presumably only a moderately strong coronoid process; it carried four medium-sized incisors, which occupy 12 mm.; the space between the last incisor and the canine measures 4 mm.; the canine is fairly large—it is compressed from side to side and both its borders are serrated; the serrations on the anterior side lie somewhat medially of the anterior border; behind the canine there is a diastema of 19 mm.; the two small molars occupy a space of 12 mm.

The prearticular is a long bone, which commences just behind the molars and continues backward to form the anterior border of the articulatory surface.

The coronoid is a flat sheet of bone, applied to the inner surface of the dentary and prearticular.

The surangular has the usual beam-shape and transmits the pressure on the dentary to the articular.

The angular is a large flat bone, forming the greater part of the posterior third of the outer surface; it does not carry the ridges, which form the distinctive pattern on the outer surface of the therocephalian angular.

The articular is small; it forms the main part of the articulatory surface; it is firmly clasped by the angular, prearticular and surangular, which thus form the bridge between the resistance on the dentary and the fulcrum situated on the articular.

***Ictidorhinus martinsi* Broom**

(Figures 5-6)

BROOM, R., 1913, Bull. Amer. Mus. Nat. Hist., XXXII, Art. xxxvii, p. 560.

BROOM, R., 1914, Phil. Trans. Roy. Soc. London, p. 46.

BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 136.

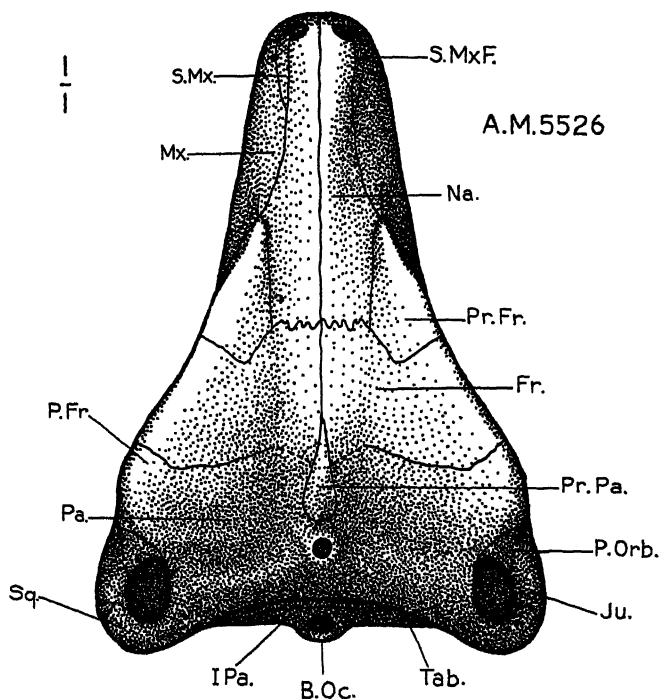
TYPE.—Amer. Mus. No. 5526, Wilgebosch near New Bethesda; *Cistecephalus* zone.

Fig. 5. *Ictidorhinus martinsi*. Amer. Mus. No. 5526. $\times 1$. Dorsal view of the skull, with the distortion corrected.

Lettering as in Figs. 1 and 2.

This remarkable little skull is clearly that of an aberrant branch of the gorgonopsians. The very great intertemporal width and the development of a thickened supraorbital ridge are reminiscent of the similar, but much more pronounced, development of these parts of the skull in the other aberrant gorgonopsian, *Burnetia mirabilis*. Broom's original figure is very misleading; his 1932 reconstruction conveys a much better idea, but it lacks details of the structure.

The dental formula is, I-4, C-1, M-4 or 5. Immediately behind the canine is a tooth which forms the first of a series of five teeth; it is, however, possible that the first tooth is not a molar, but really a replacing canine.

The snout is narrow and high, with the nostrils practically terminal; the interorbital width is very great (30 mm. across the frontals and 55 mm. across the postfrontals); the intertemporal width, although less than the greatest interorbital width, is likewise great (43 mm.); the orbits are large and somewhat longer than high; the temporal fossae are remarkably small.

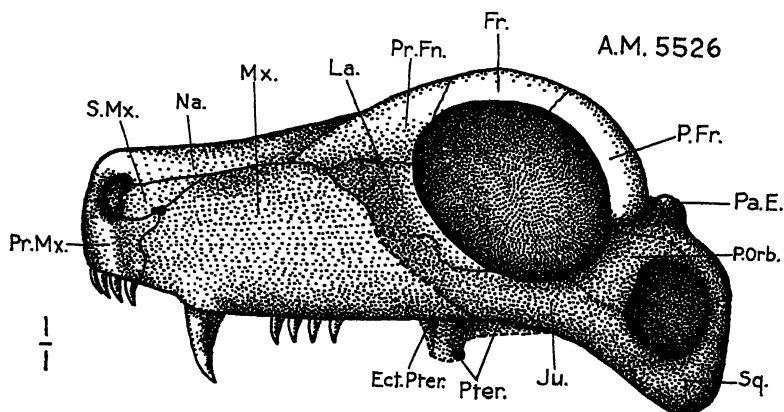


Fig. 6. *Ictidorhinus martinsi*. Amer. Mus. No. 5526. $\times 1$. Lateral view of the skull, with the distortion corrected.

Pa.E. = eminence on the parietal, on which the pineal foramen opens.
Other lettering as in Figs. 1 and 2.

The strong supraorbital ridge is formed mainly by the prefrontal and the frontal; the preparietal is relatively large and is triangular in shape; the parietal is a broad element; there is a distinct tabular; the supraoccipital, if it stretches to the tabular, would be very broad; the maxilla is high. The pineal foramen is large and is surrounded by a circular wall 3 mm. high; the posttemporal fenestrae are preserved as narrow slits above the paroccipitals.

Lycaenoides angusticeps Broom

BROOM, R., 1913, Bull. Amer. Mus. Nat. Hist., XXXII, Art. XXXVII, p. 558.

BROOM, R., 1915, Bull. Amer. Mus. Nat. Hist., XXV, Pt. II, p. 127.

BROOM, R., 1925, Rec. Albany Mus., p. 314.

BROOM, R., 1930, Phil. Trans. Roy. Soc. London, p. 370.

BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 132.

TYPE.—Amer. Mus. No. 5537, Wilgebosch near New Bethesda; *Cistecephalus* zone.

This genus was founded on a complete skull; it is laterally compressed and was extensively sun-cracked before fossilization, so that the details of structure are not shown; Broom's figure of the lateral surface showing nearly all the sutures is thus mainly inferential; he has also drawn the skull with a strong dorsal curvature; the skull, however, shows no evidence of any dorso-ventral crushing and Broom's published photograph shows the true amount of curvature. The teeth are not well-preserved, but the dental formula appears to be, I-5, C-1, M-4.

The chief measurements are:

Premaxilla to the posterior corner of the squamosal.....	300 mm.
Premaxilla to the anterior orbital border.....	170 mm.
The total length of the dental series.....	50 mm.

"*Scymnognathus minor*" Broom

BROOM, R., 1913, Bull. Amer. Mus. Nat. Hist., XXXII, Art. xxxvii, p. 559.

BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 118.

TYPE.—Amer. Mus. No. 5535, New Bethesda; *Cistecephalus* zone.

The skull is somewhat weathered and laterally compressed; only the anterior part of the left side of the snout has been cleaned by grinding—the matrix being too hard for a chisel. On the left side, five long slender incisors are visible; a space of 13 mm. is followed by one long slender canine; a diastema of 21 mm. is followed by the roots of two molars, with sufficient space between them to house another two.

On the right side, I have exposed by grinding: five incisors, the fifth being small; one very long canine, with a crown length of 52 mm.; four small, closely packed molars, which decrease in size in posterior direction. The dental formula, I-5, C-1, M-4, is as in *Lycaenoides angusticeps*; the length from the premaxilla to the corner of the squamosal (270 mm.) is less than that of *Lycaenoides*, but there are no other characters which could be cited to prove this form distinct from *Lycaenoides*. I therefore propose that the name *Scymnognathus minor* be considered a synonym of *Lycaenoides angusticeps*.

SUMMARY

1. The second known skull of *Gorgonops* is figured in dorsal, ventral and occipital view and its structure described.

2. Reasons are advanced to show that the forms *Aelurosaurus breviceps*, *A. striatidens*, *A. tenuirostris* and *A. whaitsi* are synonymous with Owen's original *Aelurosaurus felinus*.

3. The lower jaw of the gorgonopsian, *Delphaciognathus*, is figured and fully described.

4. The skull of a very remarkable little gorgonopsian, *Ictidorhinus*, is figured and its affinities are discussed.

5. It is pointed out that there are no valid reasons for not regarding *Scymnognathus minor* as synonymous with *Lycaenoides angusticeps*.

In conclusion, my thanks are due to the officers of the American Museum for the facilities enjoyed in studying the above material. To the University of Stellenbosch I am indebted for a grant enabling me to do this work. The drawings are by my wife, Esmé E. Boonstra.

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TWO NEW SPECIES OF *Formica* FROM
WESTERN UNITED STATES

BY WILLIAM STEEL CREIGHTON

Since the publication of Wheeler's 'Revision of the Ants of the Genus *Formica*' in 1913 there have been but two additional species described from the United States. This condition reflects the extensive nature of Wheeler's work and, in addition, indicates the considerable difficulty of specific recognition in this group. The strong similarity of worker belonging to several species in the genus *Formica* makes this caste very recalcitrant to satisfactory separation. Despite the uniformity of structure which marks the worker, the females of *Formica* usually possess distinct specific characters that can be easily recognized and are entirely suitable for taxonomic purposes. Wheeler utilized this fact when he established the "*microgyna* group," in which the diminutive female does not exceed the largest worker in size. The females of each of the species described in this paper possess certain morphological features that do not occur elsewhere in the genus. One in particular is worthy of special consideration since its stature approaches the small size characteristic of the *microgyna* female yet it is unquestionably a slave-maker belonging to the *sanguinea* complex. It is a pleasure to give to this unique insect the name of the man whose studies in the genus *Formica* will always be the cornerstone for future work on the American species.

Holotypes, ergatotypes, and a series of paratypes of each are deposited in The American Museum of Natural History.

***Formica wheeleri*, new species**

Figure 1

WORKER.—Length 6.5 mm. Head, exclusive of the mandibles, trapezoidal, broadest just behind the eyes with the straight sides narrowed from that point to the insertion of the mandibles. Occipital angles only slightly rounded, the median portion of the occipital border virtually straight. Clypeus with a rather narrow median lobe which is moderately convex in a lateral plane and more feebly convex from front to back. The median lobe of the clypeus is abruptly set off from the lateral portions and, although not unusually long, projects abruptly beyond them in front. Clypeal notch broad and deep. Clypeal carina very feeble. Frontal area triangular, broader

than long, scarcely depressed, feebly shining in the middle, more strongly shining at the periphery with a very faint median carinula extending a short way from the median angle. Frontal lobes short, parallel, and acutely pointed in front. Frontal furrow virtually obliterated. Eyes oval, moderately convex, their anterior border situated slightly in front of the middle of the side of the head. Mandibles stout, strongly convex in two planes and bearing seven teeth on the masticatory

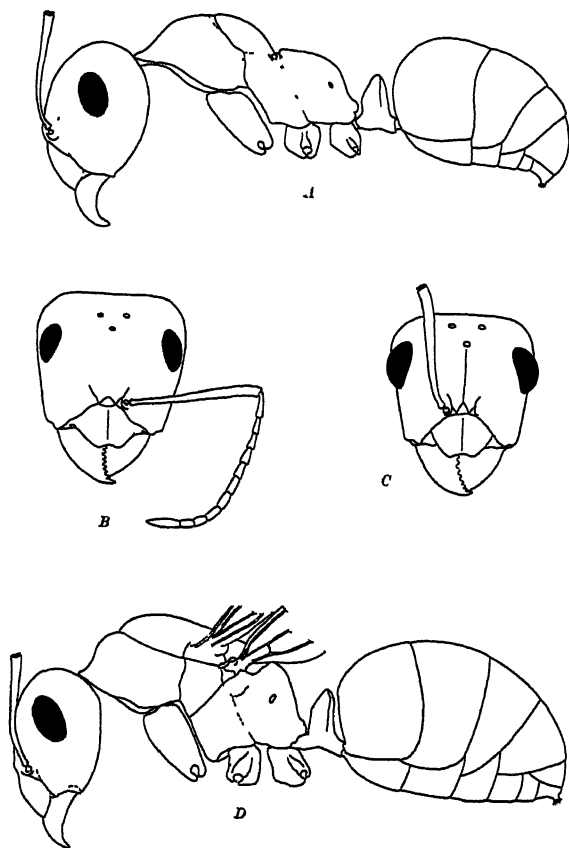


Fig. 1. *Formica wheeleri*, new species.

A. Profile view of worker; B. Head of worker; C. Head of female; D. Profile view of female. All drawings made to same scale.

margin. Antennal scapes rather stout, evenly thickened from base to apex and only slightly curved. In repose the tip of the scape surpasses the occipital margin by a distance equal to twice its thickness. All funicular joints longer than thick, joints 1-4 each increasing in diameter from base to apex, joints 5-10 somewhat thicker than the preceding joints and cylindrical in shape, the terminal joint as long as the two preceding joints together and tapering toward the apex.

Thorax in profile with the promesonotum forming a single even convexity, the promesonotal suture scarcely enough impressed to break the outline. Mesoepinotal suture narrowly and not very deeply impressed. Epinotum notably higher than long, the basal face very slightly convex, the angle between it and the declivous face well-marked and only slightly rounded. Seen from above, the thorax is stout. The pronotum has a short, stubby anterior neck and very convex sides. It is almost twice as wide as the shield-shaped dorsum of the mesonotum. Sides of the thorax at the mesoepinotal suture only slightly constricted. Behind the constriction the lower portions of the mesonotum and epinotum are parallel. Scale of the petiole low, blunt, and wide. Seen in profile, the anterior face consists of a very short, perpendicular portion at the base that passes through a broad though well-marked angle to the long upper face. The latter slopes backwards to the blunt crest. The straight posterior face slopes slightly backwards from crest to base and is feebly convex in a lateral plane. Upper edge of the node entire and only a little convex in the middle. Abdomen large but rather slender and pointed behind. Legs long with stout femora but slender tibiae and tarsi.

Front, vertex, occiput, entire thorax, and the scale of the petiole finely and densely shagreened and opaque. Genae and lower surface of the head more feebly shagreened, shining with numerous coarse but shallow punctures. Middle portion of the clypeus feebly shining with very fine longitudinal striae. Mandibles longitudinally striate, the striae coarser than those on the clypeus and the surface more shining. Antennal scapes, femora, and tibiae feebly shagreened and somewhat shining. Abdomen evenly shagreened but more shining than the thorax.

Erect hairs moderately numerous, short, pointed, and yellow. Most numerous on the clypeus and front, sparser and shorter on the vertex, absent on the occiput except for one or two very short median hairs. A tuft of erect hairs occurs on the dorsum of the pronotum, a few shorter ones are present on the mesonotum, and one or two occur at the angle between the two faces of the epinotum. Erect hairs on the abdomen much more numerous than elsewhere. They are evenly scattered over the entire surface of each of the abdominal segments but become more numerous and longer on the posterior segments. Mandibles, coxae, and femora of the fore legs and the flexor surfaces of the middle and hind femora with very fine, short, erect hairs. Pubescence fine, short, and golden. Sparse on the head, thorax, and legs where it is visible only in certain lights. Much more abundant on the abdomen but not thick enough to conceal the shagreened surface beneath. Dense on the antennal scapes and funiculi.

Thorax, petiole, legs, antennae, and lower surface of the head dull, yellowish brown. Vertex and occiput piceous brown. Abdomen a deeper piceous brown with the edges of the segments narrowly edged with black. Pronotum and mesonotum faintly tinged with irregular blotches of brown.

VARIATION WITHIN THE TYPE SERIES.—This series consists of thirty-four workers from the same colony as the ergatotype. The length varies from 5–6.5 mm. In the small individuals the sides of the head are slightly convex and the occipital border is perfectly straight. In such cases the epinotum is lower and the scale of the petiole is proportionally narrower. Slight color variations also occur, but these have nothing to

do with size and are, apparently, due to the age of the insect. Thus in some workers the piceous coloration of the upper surface of the head is confined to the occiput. In such individuals the abdomen is a lighter brown than that of the ergatotype.

FEMALE.—Length 7 mm. Eyes a little larger than those of the worker, strongly convex with their outline extending beyond the side of the head when this is viewed from the front. Frontal furrow more pronounced than in the worker. The antennal scape in repose surpasses the occipital margin by an amount almost three times its greatest thickness. Funicular joints thicker than those of the worker. In other respects the head is like that of the ergatotype.

Thorax seen from above suboval, almost as wide as the head, widest a little in front of the insertion of the fore wings. Scutum slightly broader than long, subpentagonal in outline with the median anterior angle broadly rounded. Scutellum with a feebly arcuate anterior edge and a rather strongly convex posterior border, the lateral projections narrow and long but blunt at the tip. Metanotum small, not extending entirely across the dorsum of the thorax. Seen in profile, the suture between the pronotum and the scutum is well-marked so that the slightly concave, sloping, anterior face of the pronotum is sharply set off from the descending anterior portion of the scutum. The epinotum is only a little lower than the adjacent portion of the thorax, much higher than long, and with the angle between the short, basal face and the long, declivous face well marked. Scale of the petiole much thicker at the base than in the worker and with a very much blunter upper edge. Abdomen oval, slender, and pointed behind. Legs shorter and somewhat stouter than those of the worker. Wings grayish white with veins and stigma brown.

Sculpture and pilosity as in the worker.

Piceous brown, the mandibles, legs, and antennae clear, yellowish brown. Clypeus sordid yellow infuscated along the midline. Pronotum and petiole sordid yellow irregularly clouded with piceous brown. The black bands that border the abdominal segments are less conspicuous than in the worker.

Two winged females were taken in the original colony. Except that it is a trifle smaller (6.7 mm.), the second female agrees in every respect with the holotype.

TYPE LOCALITY.—Warner Ranger Station, La Sal Mountains (9500 feet elevation), Utah. These mountains, which are close to the Utah-Colorado border, lie about fifteen miles to the southeast of the town of Moab.

Slave.—*F. (Proformica) neogagates* subspecies *lasioides* variety *vetula* Wheeler.

In addition to the type series, I have taken this ant in the Blue Mountains (some maps give these as the Abajo Mountains) which lie to the west of Monticello, Utah. This nest, as well as that of the type series, was situated on an open hillside surrounded by extensive aspen groves. The nests are constructed under stones without any accumulation of earth or vegetable detritus.

The cephalic characteristics and coloration of *wheeleri* leave no room for doubt concerning its relationship to *emeryi* and *pergandei*. Through the generosity of Dr. W. M. Wheeler, I have been able to compare the new species with types of his *emeryi*. The workers of the two species differ as follows: in *wheeleri* the head is broader, the profile of the promesonotum is more convex, the epinotum is shorter and higher and more sharply set off from the promesonotum, the constriction of the sides of the thorax at the mesoepinotal suture is feebler, the scale of the petiole is broader and thicker with the upper edge less angular and blunter. In addition, *wheeleri* is more heavily sculptured, has more numerous erect hairs and more abundant pilosity, especially on the abdomen. The differences shown by the female of *wheeleri* are much more striking. Its small size and unusually dark coloration serve to distinguish it not only from *emeryi* but also from all the other known females in the *sanguinea* group. The possibility of confusion in the case of this insect is so slight that it seems unnecessary to give additional characteristics for its recognition.

Formica curiosa, new species

Figure 2

WORKER.—Length 5.5 mm. Head, exclusive of the mandibles, slightly longer than wide, the moderately convex sides more strongly narrowed in front of the eyes than behind them. Occiput flat in the middle with the occipital angles strongly rounded. Eyes rather small, moderately convex, with their posterior border very slightly in front of the level of the median ocellus. The eyes are set well down on the sides of the head so that when the head is viewed directly from in front the eyes break the outline of the side of the head. Clypeus strongly convex both in the antero-posterior and the lateral plane. A small but distinct median, longitudinal carina is present. Clypeal notch well marked, broad but only moderately deep. Frontal area broadly triangular, scarcely depressed and somewhat shining. Frontal lobes short with their lateral margins diverging behind. Frontal furrow feeble but extending back to the median ocellus. Antennal scapes stout, gradually thickened from base to apex. In repose the scape surpasses the occipital border by one quarter of its length. Funicular joints all longer than thick, joints 1–6 each slender at the base but thickened apically, joints 7–10 cylindrical, terminal joint more slender and longer than the preceding joints. Mandibles small, their masticatory margin armed with eight teeth.

Thorax, seen from above, rather slender, the pyriform promesonotum barely one and one quarter times as wide as the epinotum, the sides only moderately constricted at the mesoepinotal suture. Seen in profile, the pronotum is evenly convex with the promesonotal suture well marked by the raised anterior edge of the mesonotum. The dorsum of the latter descends through an even curve to the broadly and shallowly impressed mesoepinotal suture. Basal and declivous faces of the epinotum of equal length, the angle between them well marked and not much rounded.

Scale of the petiole seen in profile thick at the base but sharp at the crest, the posterior face straight and perpendicular, the anterior face sharply bent in the middle with upper half sloping back to the crest of the scale. Seen from behind, the scale flares strongly from the base to the upper edge. The latter is moderately convex with a very feeble notch in the middle. The basal half of the anterior face of the scale is very convex in a lateral plane. This convexity decreases in that portion of the

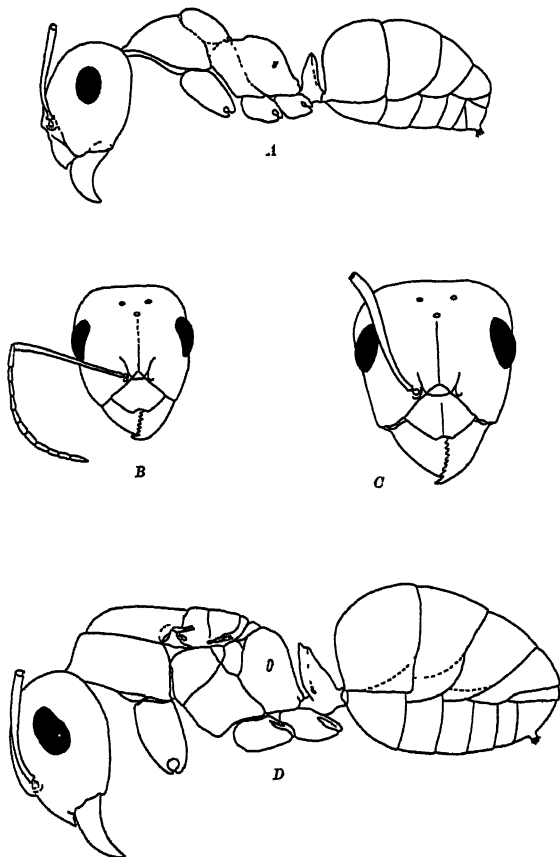


Fig 2. *Formica curiosa*, new species.

A Profile view of worker; B. Head of worker; C. Head of female; D. Profile view of female. All drawings made to same scale.

anterior face which slopes backwards to the crest of the scale. Abdomen bulky and oval. Legs long and stout with the femora slightly curved.

Thorax finely and densely shagreened, opaque; upper surface of the head and the coxae more feebly shagreened, somewhat shining; under surface of the head, the femora and tibiae very feebly shagreened, rather strongly shining and with sparse piliferous punctures; mandible punctatostriate, feebly shining.

Erect hairs short, yellow, and rather blunt, not numerous except on the abdominal segments. A few hairs are present on the clypeus, front, vertex, genae, and the dorsum of the pronotum. The angle of the epinotum and the crest of the petiole bear several somewhat shorter erect hairs. Erect hairs of the abdomen longer, more even and more abundant than elsewhere. Fore coxae and all three pairs of femora covered with rather sparse, short, fine, erect, and suberect hairs. These form a definite row on the flexor surface of each tibia and first tarsal joint and grade into pubescence on the apical tarsal joints. Pubescence absent on the head and the thorax; sparse on the lower surface of the head; more abundant on the coxae, particularly the middle and hind pair, and the antennae; very abundant on the abdomen where it forms an even gray investiture but is not thick enough to conceal entirely the shining surface beneath.

Head, thorax, petiole, and appendages yellowish red. Abdomen brown with the edges of the segments more or less tinged with black.

VARIATION WITHIN THE TYPE SERIES.—This series consists of one hundred and fifty-two workers from the same colony as the ergatotype. The length varies from 4.5–5.5 mm. The smaller workers show the same characteristics as the ergatotype. With one exception the structure throughout the type series is remarkably constant. The exception is found in the outline of the crest of the petiolar scale. In the ergatotype this bears a small, scarcely noticeable, median notch. In other specimens of the type series this notch is absent, and the crest of the scale forms an even convexity. In still others, instead of an evenly convex crest, there is a distinct, obtuse median angle. There appears to be no correlation between these variations and the size of the individual.

FEMALE.—Length 8.5 mm. Sides of the head less convex than in the worker, the head only slightly narrowed behind the eyes, the occipital angles well marked and not much rounded. Eyes a little larger than in the worker, subpyriform in outline. The antennal scape in repose surpasses the occipital border by an amount only slightly in excess of its greatest thickness. In other respects the head of the female has the same characteristics as that of the worker.

Thorax, seen from above, oval, four-fifths as wide as the head, widest at the insertion of the fore wings, the sides tapering slightly behind this point. Scutum slightly longer than wide, scutellum subtrapezoidal. Seen in profile, the pronotum is almost twice as thick as the rather flattened scutum. The anterior third of the latter is convex, but the posterior two-thirds are perfectly flat. Scutellum feebly convex and slightly higher than the adjacent portion of the scutum. Metanotum small, straplike, and slightly depressed. Epinotum narrow and high with a short, sloping basal face passing through a rounded angle to the much longer, perpendicular, declivous face.

Sculpture and pilosity as in the worker.

Uniform yellowish red, the abdomen no darker than the head and thorax, except at the posterior border of each segment where there is a narrow band of blackish brown.

In addition to the holotype, two other dealated females were taken in the same colony. These show slight differences in pilosity. The erect hairs are much sparser, particularly on the anterior abdominal segments which are virtually hairless. In addition, the abdominal pubescence is notably sparser, resulting in a feebly shining surface for that area. Although there are two of these less pilose females to one which shows the heavier pilosity, the author has chosen to regard the latter as typical. Its pilosity approximates the condition found throughout the large series of workers, and, moreover, the lack of body hairs on the other two females is what might be expected in the case of an old female or one which had met with difficulties during the nest-founding period.

TYPE LOCALITY.—Lake McGregor, Montana. This is a small lake about thirty-five miles west of Kalispell.

Slave.—*F. (Proformica) neogagates* subspecies *lasioides* variety *retula* Wheeler.

This ant was taken by the author on July 13, 1934. My field notes concerning it are as follows: "Nest in sandy soil under small stone in open pine woods near edge of lake. Slaves numerous. It is not particularly pugnacious but very inquisitive. Tends to collect in small clusters when disturbed. Relatively little brood in the nest."

The worker of *curiosa* resembles in many respects the minor worker of *sanguinea* subspecies *aserva* Forel. Since *curiosa* is virtually monomorphic, there is very little reason for the confusion of the two forms, if adequate material is available for comparison. In addition to this obvious means for separation, there are others which will apply regardless of the size of the specimens. The eyes of *curiosa* are more convex than those of *aserva* and lie nearer the genae; the scale of the petiole is sharper and narrower in *curiosa*, and its median notch, when present, is far feebler than that of *aserva*. In the case of the female of *curiosa*, we have a very simple means for specific diagnosis. As has been noted above, the color of this insect is a uniform yellowish red. When the female of *bradleyi* is discovered, it may become necessary to apply some other distinction, but until that time the concolorous female of *curiosa* is unique for the *sanguinea* group.

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AFRICAN BEES OF THE GENUS *GRONOCERAS*¹

By T. D. A. COCKERELL

The bees recorded below, unless the contrary is stated, were taken by Messrs. Lang and Chapin in the Belgian Congo, on the American Museum Congo Expedition, and are in the American Museum. One species, also in the Museum, is from Natal. It has also been necessary to include the record of *G. rufa* taken by Quarrré at Elisabethville. In recording *G. plesiosoma* it is noted that the actual type is in the British Museum, and is described in a paper not yet published as this paper is being written. *G. simpsoni* and *G. angolensis* are also fully described in the same paper.

GRONOCERAS Cockerell

Gronoceras armipygata (Strand, 1911)

Faradje, 2 females, Dec. 1912. This species was described from the male, taken in 1908 at Kassenje, Lake Albert. The female agrees so well that I have no doubt of its identity.

FEMALE.—Length 18–20 mm.; mandibles broad, not specially elongate, slightly reddish; clypeus densely punctured, with a highly polished median band; head and thorax with pale fulvous hair, becoming dull white on cheeks and pleura, and white at sides of metathorax; first two tergites with red hair, and second and third with apical pale reddish hair-bands, the rest of the abdomen above black, with thin black hair; ventral scopa yellowish white as far as third sternite (slightly tinged with reddish in middle of third), on fourth it is pale reddish, or largely suffused with blackish, on fifth and sixth black; tegulae pale testaceous; wings hyaline, conspicuously dusky at end, upper half of marginal cell with a fuliginous cloud; legs variably rufescent; hair on outer side of middle tarsi yellowish white or somewhat brownish.

Easily known from *G. plesiosoma* Cockerell by the smaller, shorter mandibles, the raised polished line on clypeus, the pallid tegulae, only the first two tergites covered with red hair, and other characters.

Since writing the above I have found a male from Faradje in the collection. It differs from the description in having red hind tarsi. The front coxae have each two spines, one long, one short and slender.

¹Scientific Results of the Congo Expedition. Entomology No. 27.

***Gronoceras benguellensis* Cockerell**

Banana, 1 male, Aug. 1915. This species resembles *G. armipygata* (Strand) in the long spines at end of abdomen, but it is separable thus:

Face broader; antennae entirely black; no light apical band on third tergite; tegulae black in middle, margin broadly rufous. *benguellensis* Cockerell.
Face narrower; third antennal joint red in front; a broad conspicuous pale hair-band on third tergite; tegulae pale testaceous. *armipygata* (Strand) (Faradje).

Strand (1914) states that *Megachile kerenensis* Friese is *benguellensis*, but this is not the case.

***Gronoceras chapini*, new species**

FEMALE.—Length about 16 mm., anterior wing 13, width of abdomen about 5; black, moderately robust, mandibles and antennae black, legs black with a little reddish suffusion; tegulae large, bright ferruginous; wings dilute fuliginous, not violaceous, upper side of marginal cell dusky. Eyes brown; face broad, the orbits parallel; mandibles broad at base, not hairy, quadridentate, the third tooth small and angular; clypeus short, densely punctured but glistening, with a sharp median keel, the lower margin simple; under side of head and region about antennae and sides of face with pale fulvescent hair; clypeus with a little pale tomentum, and long black hairs, only seen in lateral view; front and vertex with thin black hair, but reddish on occiput; mesothorax and scutellum dull, minutely sculptured, mesothorax with a shining median line on anterior half, and a shining line along front edge of scutellum; hair of thorax above fulvous, short and moss-like on mesothorax, longer, with conspicuous long brown hairs intermixed, on scutellum; hair of sides of thorax fulvous above, grading to whitish below; metathorax and first tergite with clear red hair; tergites 2 to 4 short reddish-brown tomentum, giving way to very pale yellowish at base, and on margins to white bands; fifth tergite with coarse black hair, and pale hair on margin; sixth retracted in the type, the part exposed shining and slightly hairy, the sides with black hair; ventral scopa pale yellow, black on last two sternites; basal nervure falling just short of marginal; second cubital cell long, receiving recurrent nervures near to, and equally distant from, base and apex; hind wing with cubital nervure arising considerably more distant from nervellus than in *G. holorhodura* Cockerell; legs with fulvescent hair, brightly colored on inner side of tarsi; hind tarsi very thick, the basitarsi short.

Stanleyville, March 1915, 1 female. Allied to *G. armipygata* Strand, but smaller and less robust, the external channel of the mandibles much less distinct, the clypeal keel more slender, the abdomen with much more pale hair. They agree in having a single, well-developed spine at apex of front tibiae. The upper margin of hind coxa, seen from behind, is angular, whereas in *G. armipygata* it is rounded.

Gronoceras cincta (Fabricius)

Faradje, 3 females, March, April, November. A very small male, about 13.5 mm. long, is from Stanleyville, April. It looks exactly like a male of *praetexta* (Vachal), but is easily distinguished by the structure of the end of abdomen.

Gronoceras combusta (Smith)

Natal, one female (Ac. 4874); Durban, one male (Ac. 4969).

Gronoceras felina (Gerstaecker)

Faradje, 4 females, Nov., Dec. A large species with gray hair.

Gronoceras matadiensis, new species

MALE.—Length about 17 mm., anterior wing about 13.5; black, very robust; facial quadrangle much longer than broad; mandibles black, apical tooth very long, lower margin with a broad angular lamella about the middle; clypeus very coarsely, not densely, punctured, broadly shining in middle; face and front with long, pale yellowish hair, somewhat brownish about the antennae; vertex with rusty-black hair, cheeks below with yellowish white; flagellum greatly broadened; mesothorax and scutellum dull, excessively densely punctured; hair of thorax throughout dark reddish-brown; tegulae dark reddish, the disc blackened; wings hyaline, faintly yellowish, somewhat dusky apically; second cubital cell very long; legs black, middle and hind tibiae with a red spot at end, front tibiae pallid at end; front coxae with very stout spines; front basitarsi pale yellow, short and extremely broad, second and third joints also broadened and pale yellow, the last two dusky reddish; hind tarsi very stout; hair of legs dark, the fringe of front tarsi red; abdomen covered with bright red hair, brownish on first tergite; tegument of tergites mainly red, but black at base; apex with a pair of broad red lamellae.

Matadi (13° 30' E., 6° 00' S.), June 9, 1915 (Lang and Chapin). Compared with the species generally known as *G. bombiformis*, the apical lamellae of the abdomen are conspicuously shorter, rounder, broader, less produced apically, and the thoracic hair is browner. Between the apical lamellae there is a low elevation, but no spines are visible. This is perhaps only a variety of *G. nigrocincta* (Ritsema). The type of *bombiformis* came from Inhambanc, near the southern end of Portuguese East Africa, and the description of the caudal end reads more like *G. angolensis* Cockerell than like the traditional *G. bombiformis*. *G. angolensis*, from Angola, was mixed with my series of *G. wellmani* Cockerell, but it differs by the apical armature of the abdomen, having pointed lamellae in place of long spines, and widely separated small teeth between. It is about 16.5 mm. long, and the densely, minutely punctured clypeus is totally different from that of *G. bombiformis* (as generally understood) and *G. matadiensis*.

Gronoceras musae, new species

FEMALE.—Length about 19 mm., anterior wing 11.5; robust (width of abdomen 6.5 mm.), black, including antennae, but mandibles obscurely reddish; tegulae finely punctured, very dark, but margins distinctly reddish; femora and tibiae obscurely reddish, spines of front and middle tibiae red tipped with black; clypeus with coarse black hair; sides of face, and front, with seal-brown hair, vertex with black, cheeks beneath with long white hair, stained with brownish near the eyes; mandibles elongate, with a deep broad channel on outer side, two short rounded apical teeth, and a long cutting edge, on which the teeth are represented only by a slight angulation; clypeus densely punctured, roof-like, with a shining median ridge, which at the lower end gives place to a short narrow keel; margin shining, gently concave in middle; very long dusky hairs projecting from beneath margin; vertex dullish and very finely punctured, the orbits shining; mesothorax and scutellum entirely dull, finely granular with extremely small dense punctures; hair of mesothorax thin and very short, mixed brown and pale grayish; of prothorax, including tubercles, dark seal-brown; of pleura very dark brown; of scutellum largely black, but a line of pale pubescence in suture between mesothorax and scutellum; hair of hind part of thorax, and entire first tergite, very bright and brilliant fox-red; remaining tergites with short black hair, but fringe on second red, that on third slightly reddish; ventral scopa very dark brown, pure black on last sternite; wings hyaline, marginal cell with a reddish stain at base, a dusky cloud beyond end of marginal cell; basal nervure falling a little short of nervulus; legs with thin dark or brownish hair, dark even on inner side of the stout hind tarsi, but the short spurs of hind tibiae red; front tibiae at apex with three spines, the front one black and conical, the outer one red, slender, rather long, the posterior one shorter but sharp; middle tibiae similarly spined; hind basitarsi stout but not broadened.

Banana, Aug. 1915 (Lang and Chapin). This species closely resembles *G. benguellensis* Cockerell, but *G. benguellensis* has the first two tergites covered with red hair; the clypeus not evidently ridged; the first (apical) tooth of mandibles large and long; the front tibiae not prominently spined; the hind basitarsi shorter, stouter, and more hairy; the nervures reddish (entirely dark in *G. musae*), and the apical cloud of wings larger, shining purple.

Gronoceras nigrocincta (Ritsema)

Lisala, 1 female, 2 males, May; Thysville 1 female, June; Matadi, 2 females, 2 males, June; Malela, 2 females, 1 male, July; Banana, 3 females, 5 males, July, Aug., Sept.; Boma, 1 female, 3 males, June; Zambi, 2 males, 1 female, June. A large species, with black hair on thorax, and bright red on abdomen. This is *G. bombiformis* as generally understood, but there is reason to think that the type, from Inhambane on the east coast may be different. (See also 1933, Rev. Zool. Bot. Afr., XXIII, pp. 77–79.) The species is to be called *G. nigrocincta* (Ritsema).

***Gronoceras plesiosoma* Cockerell**

Faradje, 2 females, Dec. 19. This species was described from the female, taken at Dimawo, Gold Coast (Simpson), in the British Museum. It is about 19.5 mm. long, very like *G. simpsoni* Cockerell, but differing in the larger, considerably more elongated mandibles; the clypeus rugose, the middle flattened, not at all ridged (in *G. simpsoni* it is more or less ridged, but not keeled); tegulae entirely clear red; clear part of wings hardly yellowish, apical portion very dark; abdominal segments 2 to 4 with conspicuous white hair at sides; first three tergites densely covered with very bright red hair, fourth with thin whitish hair. The abdomen of *G. simpsoni* has bright red hair, black on the last two tergites. *G. simpsoni* is closely allied to *G. quadrispinosa* (Friese), which is not identical with *G. praetexta* (Vachal), as I formerly supposed probable.

***Gronoceras rufa* (Friese)**

Elisabethville, female (P. Quarré), recorded in error as *G. holorhodura* Cockerell in Rev. Zool. Bot. Afr., XXIII, p. 81.

***Gronoceras rufa profusca* (Vachal)**

Faradje, 1 female, Nov. This has the hair at sides of face and clypeus dark brown, and dark hair on vertex. The thoracic hair is pale, but I suppose that the degree of melanism differs in different specimens. The original *profusca* came from between Mpika and Chunda, in Northern Rhodesia.

I find that I have confused two species, appearing exactly alike, under the name *G. holorhodura*, in my discussion in Rev. Zool. Bot. Afr., XXIII, p. 81. The females are separable thus:

- Mandibles long and comparatively narrow, with three teeth, the first two large, the third forming an obtuse angle; clypeus conspicuously keeled; hair at sides of clypeus mainly dark, not forming conspicuous overlapping brushes; ocelli smaller; tegulae mainly red; legs with thin red hair; front tibiae with a very long sharp outwardly directed spine at apex, and a little slender spine at posterior outer corner. (Tenke, Katanga)..... *holorhodura* Cockerell.
- Mandibles very broad, quadridentate counting inner corner, the teeth broad but short and obtuse; clypeus coarsely punctured, not at all keeled, the upper middle shining; hair at sides of clypeus red (dark in the *profusca* form) forming large converging brushes over margin; from beneath lower margin of clypeus is a little stiff fringe of pale hairs; ocelli larger; tegulae black, with red hair anteriorly (Friese describes tegulae as red-brown); legs mainly with short black hair, but the front femora in front copiously covered with long red hair; front tibiae not spined. (Elisabethville)..... *rufa* (Friese).

Vachal, in describing *Gronoceras praetexta* (1910, Ann. Soc. Ent. Belg., LIV, p. 307), sagaciously remarks on the resemblance of *Megachile rufa* Friese, and says that he would have considered *G. praetexta* to be its male, but for the fact that the mandibles have at least three teeth, whereas in the *M. bombiformis* group (my *Gronoceras*), to which *M. praetexta* belongs, they have two teeth and a long cutting edge. However, the mandibles of *Gronoceras plesiosoma* Cockerell are entirely of the same type as those of *G. rufa*, and this species also lacks the prominent spines on front tibiae.

Friese based *Megachile rufa* (1903) on the female, from Ikutha, East Africa. In the following year he described what he considered the male, from Natal. The American Museum has a specimen of this male from Mfongosi, Zululand, received from Friese. This is not at all like *Gronoceras*, and whether or not the *M. rufa* female is strictly referable to that genus, I feel sure that the assigned male has nothing to do with it. It may be added that *G. holorhodura* and *G. rufa* exist in precisely the same faunal area in Katanga, and the case adds another to the numerous instances in Africa in which two megachilid bees, actually quite distinct species, but excessively alike, inhabit the same country.

***Gronoceras tricolor* (Friese)**

Gamangui, 1 female, Feb.; Batama, 1 female, Sept.; Poko, 1 female, Aug.; Ava Kubi, 3 males, Nov.; Stanleyville, 2 males, April, May; Thysville, 1 male, June. The hair on disc of third tergite varies from practically black to reddish. In one Stanleyville male the hair on third and fourth tergites is colored alike, but in the other the third (except the apical band) has the hair black, agreeing with the second tergite and abruptly contrasting with the third.

***Gronoceras wellmani* Cockerell**

Matadi, male, June 9, 1915. The male looks like *G. bombiformis*, but is easily distinguished by the two long spines at end of abdomen.

POSTSCRIPT.—Dr. H. Bischoff has kindly furnished an account of the holotype of *G. bombiformis* in the Berlin Museum, and it is now certain that *G. bombiformis* is identical with *G. wellmani*.

EARLY AND MIDDLE TERTIARY GEOLOGY OF THE GAIMAN
REGION, CHUBUT, ARGENTINA¹

BY GEORGE GAYLORD SIMPSON

INTRODUCTION

The originally Welsh settlement of Gaiman is situated approximately in latitude 43° 16' South, longitude 65° 28' West, on the north (left) bank of the Río Chubut in Chubut Territory (central Patagonia), Argentina. The valley bottom is here alluvial, but directly north of Gaiman and its westward extension Gaiman Nuevo, an abrupt slope, in places almost a vertical cliff, rises to the high pampa level, and a similar slope faces this and bounds the valley on the south side. In these scarps is exposed a thick series of Tertiary and, according to some authorities, older strata.

These exposures are of exceptional geological interest. Among the many problems on which they do or are supposed to cast light are the relationships of the marine Salamanca to the terrestrial Casamayor Formation, the position and nature of the Cretaceous-Tertiary contact, the beginnings of Andine orogeny, the relation of the terrestrial Colhué-Huapí to the marine Patagonian Formation, the time of extinction of South American dinosaurs, and the ages of these various formations and also of the Santa Cruz Formation (not present here as such). From near here came most of the fossil Cetacea known from South America, a large percentage of the fossil penguins known from anywhere in the world, the type specimen of *Colpodon*, which has given its name to the so-called *Colpodon* Beds = Colhué-Huapí Formation, and many other very important fossils, terrestrial and marine, vertebrate and invertebrate. It is also a possible field for exploration for petroleum, which cannot be intelligently directed or its profitability reasonably forecast until the surface formations are understood.

This importance has long been recognized and the region has been studied by a number of geologists, including Roth (1908), Ameghino (1906, based on collections and data communicated to him by Roth), Windhausen (1921), and Frenguelli (1927). The Scarritt Expeditions, 1930-'31 and 1933-'34, have several times passed through or near

¹Publications of the Scarritt Expeditions, No. 23.

Gaiman, and in 1933 we spent some time there, collecting fossils at different levels and measuring several detailed geological sections. Our results are so different from what was anticipated and cast so much new light on all the problems mentioned above that it seems necessary to publish them as promptly as possible.

It should be mentioned that in 1933 we coöperated in this region with Sr. Alejandro F. Bordas, representing the Museo Argentino de Ciencias Naturales, Buenos Aires. He accompanied us while we were working there and he continued his work after we left, effecting junction with us again in a different region. His collections and data corroborate ours, although they were not directly employed in the preparation of this paper.

The late Mr. T. N. Tappen of "La Araucana," Gaiman, placed us deeply in his debt by his hospitality and assistance, and various friends in Trelew also aided us in ways less directly bearing on the present subject.

RÉSUMÉ OF PREVIOUS OPINIONS

The general nature of the problem can best be sketched by brief mention of previous views, some details of which will be more adequately discussed in dealing with our own results. Roth (1899, p. 382) was speaking of Gaiman Nuevo exposures when he wrote "el tercer yacimiento, que se halla en la costa misma del Río Chubut, se compone de una cuárzita que se encuentra debajo la formación de toba cretácea de Dinosaurios. En este sitio he encontrado restos de Mamíferos mezclados con los de Reptiles, entre los cuales abundan principalmente los de Tortugas." In view of later statements, note that the phrase applied to the tuff means "Dinosaur tuff" not "tuff with Dinosaurs" (an important distinction), that the only reptiles specified are tortoises and that nothing is said of marine shells. In 1901 (page 255) Roth named *Lelfunia haugi*, which came from this horizon and locality although he wrote only that it was from a "Formación cretácea superior," and in 1903 (p. 143) he described *Monolophodon minutus* with only the slight further data that it was from a quartzite on the Río Chubut near the [Welsh] Colony.

Ameghino at first (1901-1902, p. 41 of the separate edition of 1903) reproached Roth with the inexactness of his data and hazarded the mistaken guess that Roth's third locality, actually that near Gaiman Nuevo, was in the Valle de los Mártires.¹ Later (1906, pp. 94-95) Ameghino

¹Also on the Chubut River, but many leagues farther west. Ameghino said he had some mammal and tortoise remains from there, and Roth also later indicated mammal beds in the valley. We traveled up this valley and found no mammal-bearing formation. Roth's indication is probably an erroneous correlation, and I suspect that Ameghino's mammal teeth (never described as far as I know) came either from nearer Gaiman or from some locality well outside the valley. In any case the locality here in question was not in the Valle de los Mártires.

wrote, “. . . Les couches marines du salamanquéen sont limitées par un ruban de grès à gros grains mélangés avec des débris de coquilles triturées et avec des os plus ou moins roulés (parfois aussi intacts) de Poissons, de Tortues et de Mammifères de la faune du Noto-stylops. . . . Une des plus intéressantes localités de ce ruban, est celle découverte par M. Roth en face de Gaiman.¹ Ici, enchâssé dans la même quartzite, mêlés au coquilles triturées de la mer salamanquénne on y trouve une quantité considérable d'ossements de Poissons, de Crocodiles et de Tortues fluviales, avec des dents et des ossements de Mammifères de la faune notostylopéenne, tels que *Notostylops*, *Polydolops*, *Didolodus*, *Adpithecus*, *Trigonostylops*, etc.” The locality is correctly shown by Ameghino on the accompanying sketch map. These new data were doubtless due to personal communication from Roth, as he apparently had not then published even the exact locality and as this work of Ameghino contains reference to conversations with Roth and also other data clearly derived from personal communication.

Carlos Ameghino has informed me that he never examined this region, and it may be inferred that unpublished data from Roth were Ameghino's chief or whole authority. It is therefore surprising to find that when Roth himself published on this occurrence (1908), his statements were widely at variance with Ameghino's. He said (p. 112) “Das liegende wird von einem grobkörnigen Sandstein gebildet. In diesem habe ich die bereits erwähnten Reste der *Notostylops* Fauna gefunden. Darüber folgt hellgrauer Tuff der Übergangsformation, der hier keine Fossilien enthält. Auf diesem liegt konkordant ein etwas härtere, dunkelgraue Tuffbank, in der die eben erwähnten Säugetierreste nebst vereinzelt Meeresmuscheln vorkommen.” This description we found to be essentially correct, although the correlations are not. Roth says nothing of Salamanca shells mingled with Casamayor (*Notostylops* Beds) mammals, and we found none. I am convinced that they do not exist, because this bed is much later than the Salamanca. Ameghino's statement can only be a misunderstanding of some statement by Roth.² The same was probably true of the list of genera given by Ameghino. Any of these genera could perhaps occur here, but in fact, as far as I know, the only forms actually known then were the two named by Roth, which are generically related to or identical with Ameghino's

¹The phrase suggests that the locality is across the river from Gaiman, but it is on the same side, as correctly shown in Ameghino's map.

²The quotation from Roth shows how the misunderstanding could arise. He does speak of mingled shells and mammals, but these were supposed to be in the base of the Patagonian Formation. Ameghino may easily have understood him to mean the older mammals, in which case, according to the view they shared, the marine shells could only have been from the Salamanca.

Isotemnus and *Polystylops* and a *Polydolops* then in Roth's Collection but not described. I have studied Roth's Collection (in the Museo de La Plata) and it contains only these three genera and some fragmentary bones. There are no dinosaurs, and when Roth called this the "Dinosauriersandstein" he was expressing an opinion and not announcing a discovery. He meant merely that he thought the beds to be Cretaceous and that he correlated them with strata which do contain dinosaurs elsewhere.

It had long been known that at least part of the upper portions of the cliffs in this part of the valley is formed by the marine Patagonian Formation, and also that terrestrial mammals occur, since *Colpodon* had been found. Ameghino (1906, pp. 222-226) pointed out that these younger mammals are apparently in the base of the Patagonian Formation, and that there are terrestrial beds interstratified with the lower marine beds. He also said that at the Castillo (south of Trelew, and an outlier of the eastern extension of the cliffs opposite Gaiman) there are *Notostylops* Beds (i.e., Casamayor) below these, and he correlated them with the lithologically different sandstones near Gaiman Nuevo, across the river. In the study already quoted, Roth (1908) gave the Gaiman [Nuevo] succession as Cretaceous sandstones with *Notostylops* fauna at the base, followed by the "Transition Formation" (by which he implied correlation with the Deseado or *Pyrotherium* Beds), without fossils, and capped by the Tertiary marine Patagonian Formation with the terrestrial *Colpodon* fauna at its base.

Thirteen years after Roth's publication, Windhausen (1921) discussed the geology of this area in some detail. He stressed the fact that the lower beds, the sandstones and quartzites of Roth and Ameghino, around Gaiman on the north side of the river, consist of interdigitating sands and clays¹ and he referred them to the Salamanca Formation. He stated that the upper sandstones [and clays] of Gaiman contain no fossils. The correlation is thus based on a belief in continuity with beds, such as those farther up the valley, which do contain fossils, and (unintentionally, of course) he gives the impression that the continuity is established. In fact this is not true. The exposures are not continuous and there is no warrant for assuming that the beds at Gaiman have anything to do with the fossiliferous Salamanca elsewhere. He said (p. 23) that the clays are those considered by Ameghino as "*Notostylopeano*," Casamayor, and that if they do indeed contain the *Notostylops*

¹There is no evidence that interdigitation in the sense of Windhausen's "engranaje" really exists. The beds are lenticular.

fauna, then the Casamayor¹ clays and Salamanca sands interdigitate, and he so showed them in a diagram. This seemingly overlooks the fact that it was the sands from which the mammals came and which Ameghino considered as containing the *Notostylops* fauna, that it is not clear that the sands and clays really interdigitate (instead of simply being lenses of a unified but heterogeneous formation), and that the Salamanca age of any part of this series was an assumption based on no evidence, palaeontological or stratigraphic. In a note added later (p. 25) he announced that the clays are really part of the "Estratos con Dinosaurios," and, by implication at least, that they are not Casamayor. This also, was unsupported by any evidence. He at first agreed with Roth in considering the intermediate tuffs as of Deseado age, but in a note in the same work (p. 25) added later that they were older than the Deseado, but did not specifically state that they were Casamayor, although this seems to be implied. He also said (p. 26) that the *Colpodon* fauna occurs in the upper part of these tuffs and before the Patagonian marine transgression. In 1924 (opposite p. 194) he correlates the clays and sands, at the base of the Gaiman section, with the upper part of the "Estratos con Dinosaurios," shows a tectonic unconformity above them, then the Casamayor, an erosional unconformity, the Deseado and Colhué Huapí (conformable) and an upper erosional unconformity followed by the Patagonian marine.

Frenguelli (1927) gave many more details of these exposures, including measured sections.² Some of his correlations are discussed below in comparison with my own views. As regards the Gaiman exposures, on which attention had hitherto been largely concentrated, he believed (section p. 237 and accompanying description) that the basal sands and clays are of the "Estratos con Dinosaurios" and are tilted and followed by an angular unconformity above which begins immediately the Patagonian with the mammals in its upper part and not in (Roth, Ameghino) or below (Windhausen) its base. He stated that no fossils occur in the sands, overlooking Roth's correct record of mammals and reptiles there. On the other (south) side of the valley, opposite Gaiman, he shows the same situation (p. 227 and descriptive text), except that here the mammals found by him were from a thick (30 meters) unsubdivided member forming the lower third of the Patagonian marine. He believed these

¹Here and elsewhere it seems less confusing in indirect quotation to employ consistent geographic terms as much as possible even when the original author used some different equivalent.

²In discussing Frenguelli's interpretations of this part of the section, with most of which I cannot agree despite the accuracy of his field observations, it should be emphasized that he was primarily concerned with the uppermost marine beds of the south side of the valley and that his discussion of the older strata is incidental. These upper beds are not considered in the present paper, and consequently Frenguelli and I have concentrated on different parts of the section and discrepancies are not surprising.

mammals to be of Santa Cruz age. He drew the conclusion, inescapable on these premises, that the Casamayor, [Musters], Deseado, and Colhué-Huapí are here lacking and that the marine Patagonian Formation is represented only by its upper part, synchronous with the Santa Cruz.

To these various conflicting opinions, I now find it necessary to add another, radically different from any of them.

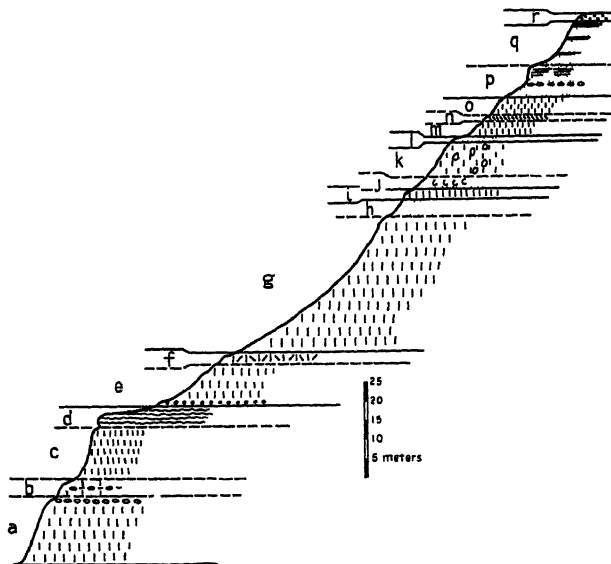


Fig. 1. Section of the south wall of the Chubut Valley, opposite Gaiman.
For description and explanation of reference letters, see Section 1, in the text.

SECTIONS

From five measured sections made by the Scarritt Expedition, I select two to illustrate the conditions on the south and north sides of the valley. Each section is given in temporal order, the oldest strata first.

1. South side of the Chubut Valley, opposite Gaiman (Fig. 1).

- a. Very massive yellowish tuff, upper meter, more or less, with platy and honeycomb concretions. Base not exposed..... 18. meters.
- b. Somewhat platy yellowish tuff, with various local concretionary zones..... 4.5 m.
- c. Pale massive tuff, few concretions..... 13.5 m.
- d. Very irregular, hard, rusty to yellow tuff with opaline concretions..... 5.5 m.

41.5 m. 41.5 m.

Plane of Erosion

e. Massive gray tuff with basal conglomerate. Land mammals. No marine fossils.	11. m.	
f. Soft, yellowish tuff with gypsum seams. No fossils.	3. m.	
	14. m.	14. m.

Sharp Division Probably an Erosion Plane

g. Thick-bedded, pale, yellowish tuff. Sparse <i>Ostrea hatcheri</i> , numerous sharks, rays, cetaceans, penguins.	35. m.	
h. Tuff and fine cross-bedded sandstone.	4.5 m.	
i. Hard, pale tuff.	2.5 m.	
j. Fine, soft, cross-bedded sand. Crabs and sand- filled burrows with molluscs.	3. m.	
k. Gray tuff, some <i>Ostrea hatcheri</i> . Sandy bur- row fillings.	9. m.	
l. Sandy tuff and sand with many shells.	1.5 m.	
m. Massive yellowish tuff.	4. m.	
n. Sand and tuff.	1.5 m.	
o. Pale yellow tuff.	4.5 m.	
	65.5 m.	65.5 m.

Possible Plane of Erosion

p. Sandstone, yellow in lower and greenish-gray in upper part. Upper meter, more or less irregularly cemented. Local oyster banks.	8.5 m.	8.5 m.
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Apparent Conformity

q. Pale yellow to pink, finely laminated sandstone, partly cross-bedded, some loess-like clay. No fossils seen.	11.5 m.	11.5 m.
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Plane of Erosion

r. Heavy gravel.	2. m.	2. m.
		143.0 m.

This corresponds approximately to Frenguelli's "Bryn Gwyn" section (1927, fig. 27), although apparently not taken at exactly the same part of the long cliff. My a-d is his Y and my e-o his X. The correspondence of the upper beds, which I did not study except to continue the line of measurements through them and which are not as thick

here as where Frenguelli took his section, is not so clear but probably my p is his A and my q his B.

2. "Pan de Azúcar" at Gaiman Nuevo (Fig. 3).

a. Soft, fine, argillaceous sandstone. Base not exposed.....	8.5 meters.	
b. White to pink arkosic sandstone. Turtle, crocodile, and mammal remains.....	1. m.	
c. Soft, white argillaceous sandstone and greenish gray clay or bentonite.....	9. m.	
d. Hard, lenticular sandstone, often weathering orange.....	6. m.	
	24.5 m.	24.5 m.

Possible Erosion Plane

e. Yellowish and greenish clay or bentonite.....	4. m.	4. m.
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Possible Erosion Plane

f. ¹ Tuff and bentonitic tuff. The lower part pale greenish-gray and more bentonitic, the upper part purer ash, hard and massive. Many concretions, especially in lower part.....	41.5 m.	
g. ¹ Hard gray tuff.....	2. m.	
h. ¹ Yellowish tuff, the lower four or five meters harder and with <i>Chubutolithes</i>	11.5 m.	
i. ¹ Very irregular concretionary tuff, showing ancient weathering.....	4.5 m.	
	59.5 m.	59.5 m.

Marked Erosion Plane

j. Massive tuff with thin basal conglomerate. Land mammals.....	5.5 m.	5.5 m.
k. Somewhat more yellowish tuff with <i>Ostrea hatcheri</i> and other marine molluscs.....	Top eroded and thickness of whole bed not determinable.	

93.5 m.

This corresponds with Frenguelli's "Pan de Azúcar" section (1927, Fig. 37). My a-e is his Y, my f-i his Xa-Xf, and my j-k his Xg-Xi.

¹Beds f-i were actually measured about one kilometer from the Pan de Azúcar, but there they have almost exactly the same thickness and character.

My *h* is his *Xc-e*. I found the thickness of the tuffs below that (my *f-g*, his *Xa-Xb*) to be 13.5 meters greater than he gives it, a marked discrepancy doubtless due to different methods of measuring,¹ to the fact that I measured them not on the Pan de Azúcar itself but on an adjacent cliff, and to the fact that he gives the thickness of his *Xa* as only approximate.



Fig. 2. Sketch of part of the south wall of the Chubut Valley, near Section 1 (Fig. 1).

The extreme upper part of the slope to the right is formed by post-Patagonian sandstones (*p-r* of section) and the main part of the slope, upper right, and the top of the small outlier, near the middle, by the Patagonian (*p-o* of section). The Trelew (*e, f* of section) forms a thinner horizontal band across the midline of the sketch, and the broken area below this is developed in the barren ?Casamayor (*a-d* of section).

FOSSILS

Section 1, stratum *e*. Although the fossils of this horizon are generally poorly preserved, they are fairly common and varied. Preparation is difficult and has not yet been done. The following identifications are believed to be exact, as given, but lack detail. In no case has a specific determination been possible. If conditions permit, a description of the fauna as such will appear later. At present, enough is known to make the stratigraphic relations fairly clear.

¹My measurements were made by working up the section with a hand level, correcting for dip where necessary.

XENARTHRA

Megalonychidae

Gen. et sp. indet. Gravigrade, and apparently megalonychid, remains occur but no more exactly identifiable specimen is available to me.

Dasypodidae

?*Stegotherium* cf. *variegatum*. Isolated scutes agree almost exactly with Ameghino's description of this Colhué-Huapí species, but such scutes are inadequate for certain identification.

Gen. et sp. indet. A badly preserved skull does not appear to belong to any Santa Cruz genus in which this part is known, and comparable remains are not yet known from earlier formations. There are also some scutes which do not agree exactly with any yet described.

Glyptodontidae

?*Propalaeohoplophorus* sp. A number of scutes and a toothless jaw fragment seem to be of this genus, which ranges from the Colhué-Huapí into the Frías (post-Santa Cruz) Formation.

RODENTIA

Erethizontidae

Aff. *Sciамys* sp. A lower jaw represents a small rodent manifestly allied to the Santa Cruz *Sciамys* but generically distinct and apparently more primitive. It does not belong to *Protacaremys*.

LITOPTERNA

Proterotheriidae

Aff. *Thoatherium* sp. A partial lower jaw has characters both of *Licaphrium* and of *Thoatherium* of the Santa Cruz fauna. It may possibly be *Prothoatherium*, of Colhué-Huapí age, but Ameghino's description of the talonid of M_3 in that genus is not exactly applicable to this specimen.

Macraucheniiidae

Theosodon sp. Poor material represents a form almost certainly of this genus, although apparently not of any known Santa Cruz species. It is very distinct from the Colhué-Huapí *Cramauchenia*.

NOTOUNGULATA

Leontiniidae

Colpodon sp. Several imperfect specimens are clearly of this genus. They do not agree exactly with Burmeister's specimens of *C. propinquus*, but the differences may not be specific. The type locality of the latter species is in this region, "near the mouth of the Río Chubut," and it is also recorded by Ameghino from the Colhué-Huapí Formation.

Interatheriidae

Cochilius sp. This Colhué-Huapí genus is common, and as far as I can observe its near allies *Interatherium* and *Protypotherium* of the Santa Cruz do not occur. Some specimens are very near *C. volvens*, but might prove to be specifically distinct, and there is a possibility that two species are present.

Hegetotheriidae

Hegetotherium sp. A common hegetothere is unlike any described Santa Cruz species, and might even be generically distinct although certainly

very close to *Hegetotherium*, which is common in the Santa Cruz and reported in the Colhué-Huapí. It may belong to *Tegheotherium*, which is from somewhere along the Río Chubut, but the agreement with Ameghino's description is not exact.

Gen. et sp. indet. Another hegetothere, intermediate in size between that just mentioned and the next, does not appear to belong to a described genus.

Pachyrukhos sp. Several jaw and skull fragments approximate *P. politus* of the Colhué-Huapí in size and may be of that species. The genus is reported at many horizons from the Colhué-Huapí to the Pampean.

This fauna is manifestly of Colhué-Huapí or Santa Cruz age or intermediate between the two. *Colpodon* and *Cochilius* are so far known only from the Colhué-Huapí (and perhaps earlier, in the case of *Cochilius*). *Theosodon* has not hitherto been reported in beds earlier than the Santa Cruz. *Propalaeohoplophorus*, *Hegetotherium*, and *Pachyrukhos* have reported ranges from the Colhué-Huapí into the post-Santa Cruz. The forms listed as allies of *Sciамys* and of *Thoatherium* are not exactly identifiable with known genera, but both suggest pre-Santa Cruz age. The preponderance of evidence thus definitely favors pre-Santa Cruz age. Equivalence with the Colhué-Huapí is entirely possible, but the facies is clearly different and the age may be slightly different, in this case a little later. The occurrence of *Theosodon* does not contradict this conclusion, for many Santa Cruz genera also occur in the Colhué-Huapí, and *Cramauchenia* is not a truly ancestral form.

Section 1, stratum *g*. We found only marine fossils in this thick unit, molluscs, sharks, rays, penguins, whales, etc. Frenguelli (1927, p. 230), however, reported *Theosodon gracilis*, *Hegetotherium mirabile*, and *Zaëdius proximus*. The *Theosodon*, which he figures, is apparently the same as that found by us. Our specimen, at least, does not appear to me to belong to *T. gracilis*. The *Hegetotherium* is perhaps the same as ours, but as Frenguelli only lists this without figure or description this is not certain. Our specimens, as already noted, do not belong to *H. mirabile*, although more fragmentary remains might be mistaken for that species. The *Zaëdius proximus* was identified from scutes, not figured. Being based solely on scutes, the identification is necessarily very uncertain.

It seems very possible, if not probable, that Frenguelli's specimens were from our stratum *e*, and not in actual association with marine fossils, as Frenguelli did not distinguish the three strata here called *e*, *f*, and *g* from each other, including the first two and most or all of the last in his X3. There is, however, the possibility that land mammals do occur in stratum *g*, and that we failed to find them. We did find some very scanty

and isolated edentate remains *on* but not *in* these marine beds. They may have weathered out of them, but the possibilities of transport from higher, or even from lower, terrestrial strata are too great to consider this as conclusive evidence. The marine beds were in large part deposited near the shore, and sporadic land mammals could occur, but there is no conclusive evidence that they do. In any case, the general interpretation of the series is not affected.

I cannot agree with Frenguelli that his mammals prove that the Patagonian exposures near Gaiman are synchronous with the Santa Cruz. The *Zaëdius* or *Zaëdius*-like scutes have no definite bearing on the

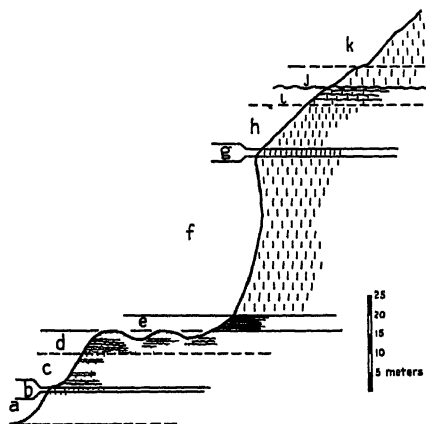


Fig. 3. Section of north wall of Chubut Valley near Gaiman Nuevo.

For description and explanation of reference letters, see Section 2, in the text.

matter, as similar scutes, hardly distinguishable in isolated examples, occur at many pre-Santa Cruz horizons. If, as seems probable, the *Theosodon* and *Hegetotherium* remains are of the same species as those found by us, they could be as old as the Colhué-Huapí. The Colhué-Huapí and Santa Cruz faunas are closely allied, although one is pre- and the other post-Patagonian. They often can hardly be distinguished save on the basis of large collections or fortunate finds of the more distinct genera. If Frenguelli's fossils are from the marine beds, they are probably intermediate in age between Colhué-Huapí and Santa Cruz, and I see no evidence opposed to this possibility.

Section 2, stratum *b*, and similar sandstone lenses in the same formation at somewhat different levels.

Diligent search in these sandstones almost anywhere will reveal a

few bone scraps. Teeth are excessively rare, but do occur. Including the Roth specimens surely from this formation at or near this locality, the following forms are so far known to me:

Turtles—numerous fragments.

Crocodiles—rare small scutes and other fragments.

Snakes—rare vertebral fragments, some of large size and suggesting *Madisoia* but not as large as the type of *M. bai*.

Mammals—

Polydolops, new species, small and apparently rather primitive.

Monolophodon minutus Roth = ?*Polystyllops minutus*.

Lelfunia haugi Roth = *Isotemnus haugi*.

Gen. et sp. indet.—A small and primitive notoungulate probably belonging or allied to the family Notopithecidae.

The age can only be Río Chico or Casamayor, as no animals closely similar to these occur at any other levels. Either is possible, but Río Chico age is more probable. The fauna, as far as it goes, suggests this, as the mammals are apparently distinct and primitive species belonging or allied to the more primitive genera of the Casamayor, which is typical of the Río Chico fauna.

Section 2, stratum *h*. This is the level of *Chubutolithes*, a very peculiar concretion or fossil of uncertain origin. The name was given by Ihering (1922) who considered the supposed fossil as probably an invertebrate. Windhausen (1921, p. 26) says that “la interpretación más aceptable es que son coprolitos procedentes de la fauna del *Pyrotherium*.” Schiller (1925, p. 36) records their presence also in the vicinity at Bahía Solano, north of Comodoro Rivadavia as “un *Problematicum*, sumamente notable . . . , que no hemos podido determinar ni mis colegas ni yo. Tampoco lo reconocieron los paleontólogos más famosos del mundo. Casi me inclino a opinar que se trata de un *celenterado*” (italics Schiller’s). Frenguelli (1927, pp. 239 and 252) also comments on them, concluding that “a lo sumo podríamos afirmar que ellos representen el molde de la cavidad de algún organismo inferior, que podría ser tanto un celenterado, como un tunicado, etc.”

These peculiar objects are nodules generally 30 to 60 mm. in length, ovoid or more elongate, and occasionally quite irregular in shape as if roughly molded of plastic clay and then indented or otherwise deformed. They are composed of volcanic ash of the same character as the matrix in which they occur, cemented with about ten per cent. of calcium carbonate (Frenguelli, 1927, p. 239). The surface is delicately sculptured with indented lines, circling or spiraling around the long axis of the nodule, and between these lines, which are generally 10 to 15 mm. apart,

there are lesser lines, approximately in the direction of the long axis but always strongly curved (all in the same direction) and anastomosing. The effect, as Windhausen said, is much as if a feather had been wound around the nodule. This strange and delicate sculpturing sometimes covers the nodule completely, and in other cases is clearly developed only on one side, the other being smooth or irregular. More aberrant forms are flattened and almost circular, one side rough (or apparently

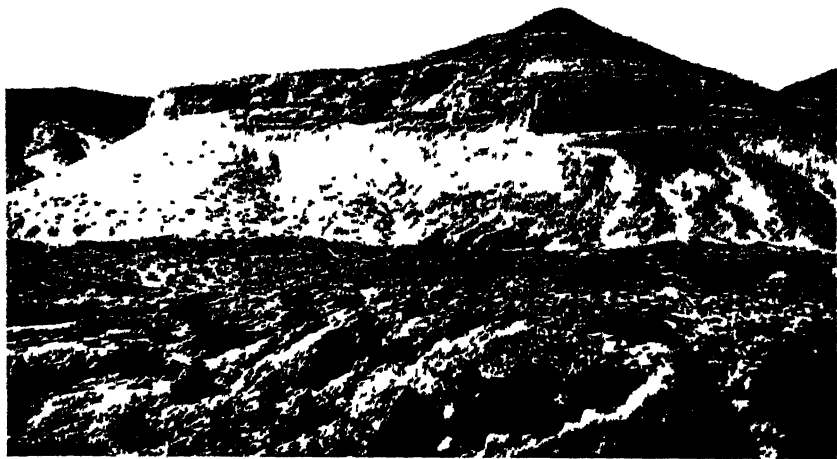


Fig. 4. The Pan de Azúcar at Gaiman Nuevo. This is the exposure of which a section is given in Fig. 3.

The bench in the foreground is developed on stratum *d* of the section, probably Río Chico Formation, and *e* forms the base of the slope beyond this. The rest of the lower slope, the vertical part of the cliff, and the lower third of the upper slope are the series *f*-1, "Casamayor." The hard bed *g* forms the cornice, top of the vertical cliff, and *Chubutolites* occurs just above it. The apex of the hill is formed by the Patagonian Formation, with the here thin and doubtfully separable Trelew beds at its base.

attached to normal matrix) and the other with one main line and the curving network on each side. Not all the nodules show the sculpture, which is intensified or perhaps occasionally developed by weathering (the pattern in any case clearly predetermined by the structure of the nodule). Some contain masses of crystalline calcite, and a few are septarian.

I cannot hazard any definite guess as to the origin of these very strange objects. They are not marine, for they certainly occur in terrestrial strata near Bahía Solano and probably also at Gaiman. They probably are natural molds or casts, since the material is the same as the matrix except for the greater amount of calcium carbonate and they probably are organic in at least a broad sense of the word.

Schiller believed the strata in which they occur at Bahía Solano to be perhaps *Pyrotherium* beds (= Deseado). Frenguelli points out that they cannot be considered guide fossils of this horizon, and believes them probably to be in the Patagonian at Gaiman. As pointed out below, this level is almost surely pre-Patagonian at Gaiman, and possibly Casamayor. It is therefore interesting to note that the beds in which they occur near Bahía Solano are also Casamayor, and not Deseado, as definitely proven by fossils collected there by us and by others. If they are organic and typical of one formation, which is hypothetical but not inconsistent with the known facts, then they characterize the Casamayor.

Section 2, stratum *j*. We did not work long on this horizon and found few mammal remains. The most definitely identifiable is the same species as the unnamed hegetothere of intermediate size from Section 1, stratum *e*. Both Roth and Windhausen, correctly in my opinion, considered the mammals as in or immediately below the base of the marine Patagonian, and Ameghino identified Roth's material as belonging to his *Colpodon* fauna. Frenguelli considers the horizon as 42.5 meters above the base of the Patagonian, but only one to four meters above the lowest recorded marine fossils. It seems probable that his terrestrial mammals are from slightly below the marine fossils in the same exposures (even if only a few centimeters), although of course not impossible that they are really in the base of the marine beds. The situation is similar to that on the other side of the valley, and it seems reasonably certain that this stratum corresponds with *e* of Section 1.

STRATIGRAPHIC DIVISIONS AND CORRELATION

Considering only the base of the Patagonian Formation and the older rocks, there are in this series three distinct changes in lithology, fossils, or both. The highest of these is between *f* and *g* of Section 1, and *j* and *k* of Section 2. I believe that these beds correspond, that is, *f*, Section 1, with *j*, Section 2, and *g*, Section 1, with *k*, Section 2. Frenguelli's very different opinion, which places the beds cited in Section 2 at a much higher level than those of Section 1, was based largely on the probably erroneous identification of the next lower break, discussed below.

The distinction here is that in the lower beds, f, Section 1, and j, Section 2, land mammals occur and marine animals are rare or absent, while in the overlying beds land mammals are rare or absent and marine animals are abundant. On the north side of the valley, as typified by Section 2, there appears to be no unconformity at this point. The change cannot be exactly localized, save for a slight color difference, but in the lower member, from 0 to 6 meters in thickness, mammal bones are

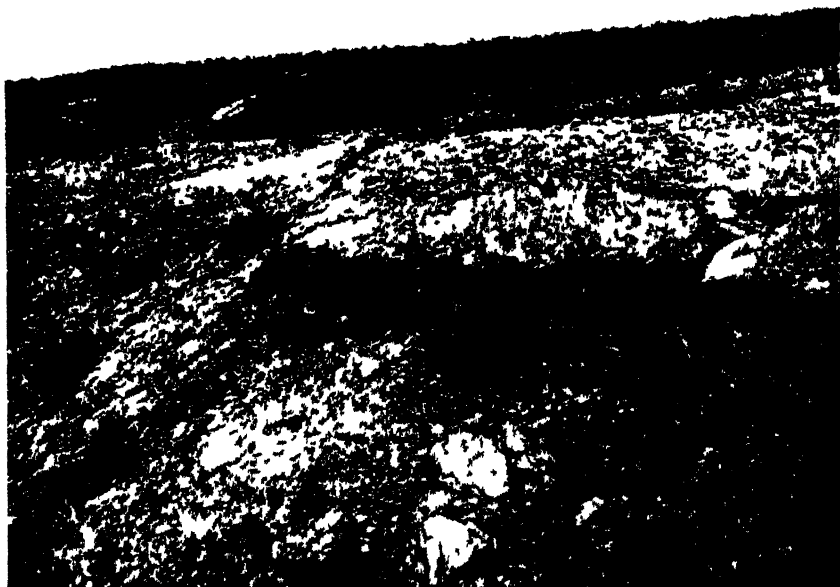


Fig. 5. Small exposure in valley slope southeast of Gaiman, corresponding with the partial section in the text.

The pale tuff in the upper part of the picture and the hard yellow sandstone above the pickhead are Patagonian. The pick is inserted at the erosion plane, more clearly visible to the right of the pick. Below this is the fine, steel-gray sandstone without fossils. Down the sanjón to the left, below the area covered by the photograph, are tuffs with land mammals and no marine fossils.

present and above that they are very rare or absent. We did not actually find land mammals and marine fossils at the same level, the mammals always being below any marine forms in the immediate vicinity, but in some places the difference in level was only a few centimeters, without a clear intervening plane of division. Some other observers speak of the land and sea fossils as mingled. Since the series appears conformable, and since the lower bed in question is variable in thickness and sometimes pinches out entirely, they may only have meant to describe the condition

we found and not to imply actual association of the two types of fossils at one level and place. However, I see no reason to doubt that the latter may occasionally be true, although this would not negative the fact that a division, even if conformable, does exist. The general appearance and other data suggest the theory that still unconsolidated terrestrial sediments were here present when the sea advanced. Being unconsolidated, they did not always form a sharp contact with the later marine



Fig 6 Detail of concretionary mass in the left-hand side of the exposure shown in Fig. 5.

These appear to be burrows extending from the erosion plane into the underlying softer sands, filled with the coarser sand and triturated shells of the overlying basal marine Patagonian. Larger and simpler burrow-fillings are also common, and the terminal fragment of one is seen in the lower part of the photograph, to the left of the middle.

beds, and in places may even have been churned up or reworked so as to cause some mingling of marine and terrestrial organic remains. I do not believe that the lower bed of Section 2, j, was originally marine, with a few land animals accidentally entombed in it.

On the other side of the river in the vicinity of Section 1 (and for several leagues down the valley), the condition is much clearer. Bed f, the equivalent of j in Section 2, is more constant and thicker, 14-15 meters as against 0-6 on the north side. In spite of long search, we did

not find any trace of marine fossils *in situ* in this bed, and it seems highly improbable that they are present. Contrary statements are perhaps due to failure to recognize the presence of a division and to record the precise levels of fossils with respect to it. The top of the terrestrial horizon is almost everywhere sharply delimited when well exposed. The rocks are soft and usually covered with wash, in which case the vicinity of the contact can usually be recognized by a yellower, rusty, and often concretionary zone. When well exposed, there is a sharp and definite bedding plane, with marine fossils above and land mammals below.



Fig. 7. El Castillo, south of Trelew. The whole exposure is in the lower half of the Patagonian Formation. *Ostrea hatcheri*, shark, penguin, and whale remains are common.

Although not together, we found these in places *in situ* within a few centimeters of each other. In a peculiarly favorable exposure two kilometers east of Section 1 (see Fig. 5), the following series occurs (from top to bottom):

Massive tuff with marine fossils—not measured here.

Hard, coarse, yellow sandstone with many shell fragments. From it many burrow fillings lead down into the underlying bed.....0.3 meter.

Soft, steel-gray, fine, cross-bedded sandstone, without fossils except those obviously filling subsequent burrows and really part of the overlying bed.

4.5 m.

White to yellowish tuff, platy toward the top. Land mammals. No marine fossils.....9.5 m.

The presence of a disconformity, or parallel unconformity, below the marine sandstone is here obvious. Below the lowest bed listed is the next unconformity, discussed below.

The inevitable conclusion is that there is here a separate formation which is terrestrial and which contains at least the majority of land mammals collected at this general level in this region. The possible occurrence of occasional isolated land mammals in the overlying marine beds does not affect this conclusion. The time lapse between the deposition of this formation and the incursion of the Patagonian sea was probably slight, as indicated both by the resemblance of this fauna to others clearly post-Patagonian and by local apparent conformity, due, I believe, to the fact that the terrestrial sediments were not consolidated when the marine invasion occurred.

As shown by the fossils, discussed above, the age of this formation is either Colhué-Huapí or slightly later. In view of the wide geographic separation from the typical Colhué-Huapí, the distinction in facies and the possibility of slightly different age, I propose to continue provisional use of the name Trelew (or Trelewense) for this horizon, as proposed by Kraglievich (1930, pp. 157, 160).¹

On the south side of the valley (see Figs. 8-9) there is everywhere a very obvious unconformity between beds d and e of Section 1. In the formation below this level, no fossils have ever been found, while above it land mammals are fairly common at some localities. The contact is a broadly flat but sometimes locally irregular plane of erosion which is clear and definite wherever it is exposed. Furthermore the lower formation terminates above with a prominent, cornice-forming, platy, irregular, concretionary tuff often brighter in color than the rest of the series and very prominent in the landscape. I believe the special character of this bed to be due to ancient erosion and surface weathering in the time preceding the deposition of the Trelew beds. Frenguelli definitely and also others previous to him, as nearly as one can judge from the scanty published references, believed that this unconformity is found on the north side between the clay-sandstone series and the tuffs, between beds e and f of my Section 2. I am convinced, on the contrary, that it is between my i and j. In the latter position Roth recognized a formation

¹Kraglievich considered his name a substitution for Ameghino's "Colpodonense," and hence equivalent to the older name Colhuehuapiense of Carlos Ameghino, in the sense in which Frenguelli and I also use that formation name. The type locality of the Trelewense is, however, the region of Trelew, not only because of the derivation of the name but also because Kraglievich explicitly gave it because *Colpodon* was found near Trelew. The assumption that Trelewense in this sense and Colhuehuapiense in the Carlos Ameghino-Frenguelli-Simpson usage are the same formation is still unwarranted. That is a correlation which perhaps can be decided, positively or negatively, later. Ameghino's "*Colpodon* fauna" was not from near Trelew but almost entirely from south of Lago Colhué-Huapí.

contact (the top of the "Transition beds" = Deseado in his opinion), but Frenguelli shows no division here (1927, Fig. 37 and p. 239, his beds f and g) and believes the rocks both above and below this level to belong to a single, unified subdivision of the Patagonian.

The contact of e on d in Section 1 and that of j on i in Section 2 are practically identical in appearance and nature. On both sides of the valley, similar, massive, barren tuffs lie below the contact. On both sides



Fig. 8. South side of the Chubut Valley opposite and downstream from Gaiman.

The vertical exposure is the barren Casamayor, capped by the cornice-forming, contemporaneously weathered bed. The Trelew beds, poorly exposed, occur on the bench above the cornice. The lighter part of the slope in the distance is the Patagonian Formation and the darker upper part the later sandstones.

the bed immediately below it is a hard, irregular, platy tuff. On both sides the contact itself is a sharp erosion plane; on both it is immediately overlain by a relatively thin tuff with land mammals (apparently of identical age on the two sides), which in turn give way to beds with many marine fossils. If the older correlation is accepted, it is necessary to believe that the massive barren tuffs of the south side become mammal- and reptile-bearing sandstones and clays in the few miles separating the exposures; that the irregular contact tuff disappears in this distance while

another of the same character (the only one in the section) appears at a very different level; that the fossiliferous mammal tuffs on the south side become completely barren and different in aspect on the north while a similar bed with the same sort of mammals appears at a much higher level; that very richly fossiliferous marine beds become completely barren; and that of the two closely similar contacts to be seen on the two sides, that on the south is the most important break in the whole

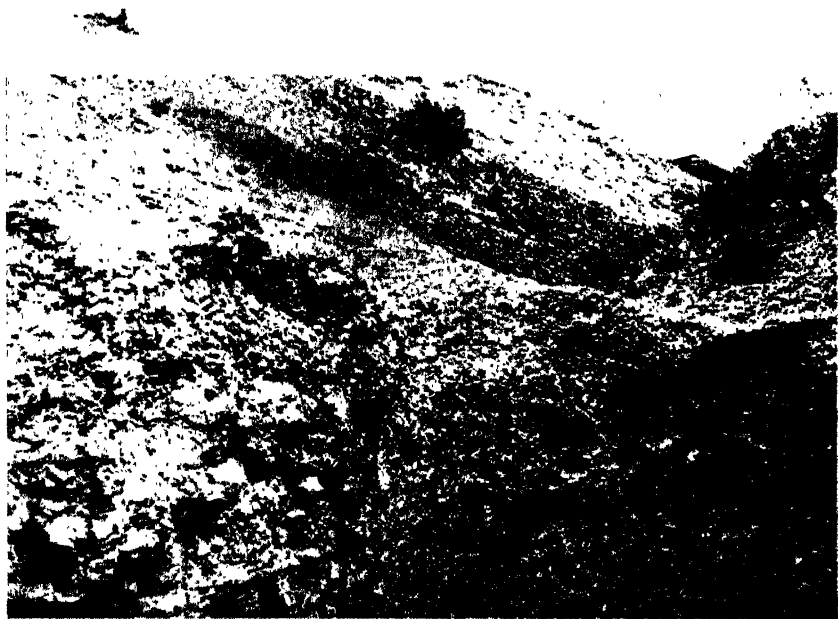


Fig. 9. Trelew beds overlying the platy top of the ?Casamayor, south of Gaiman.

series, while that on the north is not a break at all. The new correlation here proposed seems to be beyond any reasonable doubt.

The age of the barren tuffs a-d, Section 1, and f-i, Section 2, is doubtful. It is below, and hence older than, the Trelew, and the nature of the contact suggests that the age difference could be considerable. It is above beds probably of Río Chico age, and the contact does not very definitely indicate whether the lapse is long or short. The only suggestion of a fossil is *Chubutolithes*, which casts little or no light on the problem. This barren division must be either Casamayor, Musters, or Deseado.

Any one of these is possible, but Casamayor is somewhat more probable. Lithologically it resembles the more southern Casamayor slightly more than it does any exposure of the other two formations known to me. Its relations to the underlying sands and clays are very like those of the Casamayor to the Río Chico in the vicinity of Puerto Visser and Pico Salamanca. Even the extreme scarcity or absence of fossils is somewhat less surprising for a Casamayor exposure than it would be for one of the Musters or Deseado, and *Chubutolithes* occurs definitely in the Casamayor farther south.

The base of this formation is not exposed on the south side of the valley, but on the north side it is between either d and e or e and f of Section 2. I cannot decide whether e, a bed of clay or bentonite four to four and a half meters in thickness, is part of the lower clay and sandstone series or of the upper bentonitic tuff series. Either the upper or the lower contact could well be an erosion plane. Wherever the exact point of division may be, the lithologic difference between the two series is very marked and all students have agreed that they represent two different formations. It has previously been agreed that the lower formation, the sandstones and clays of a-d, Section 2, are Cretaceous. As they contain Tertiary guide fossils, this is, of course, impossible. Aside from the faunal evidence, given above, their closest resemblance in lithology and also in their relations to the overlying tuff series is with the Río Chico, and it seems probable that they do belong to that formation. As for the older view (Roth, Ameghino, Windhausen) that they represent the Salamanca, this seems impossible, and no good evidence for it has ever been adduced except Ameghino's statement that Salamanca fossils are found in them, which is not true and must have been due to his misunderstanding some statement of Roth's.

STRUCTURE

Very important for many problems of South American geology is the belief, recently and in most detail expressed by Frenguelli but shared by most other geologists, that in this region there is a folded lower series, hitherto considered Cretaceous, followed with angular unconformity by a horizontal or much more feebly folded upper series. In the first place, it is clear that this angular unconformity, if it exists, is not the Cretaceous-Tertiary contact but is in the Tertiary series. In the second place, I could find no evidence in the field that the angular unconformity actually exists at the levels where it has been indicated.

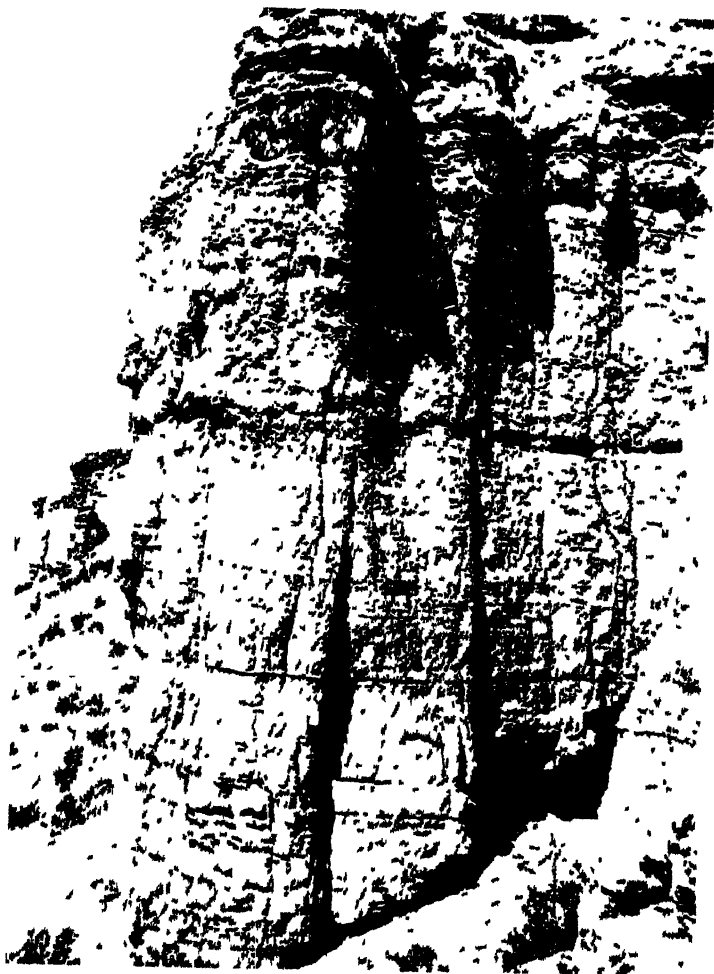


Fig. 10. Part of the thin-bedded series on the south side of the Chubut Valley at La Angostura, above Gaiman.

The most important evidence adduced for this angular unconformity is briefly this:

1. Several isolated exposures of the Río Chico ("Dinosaur beds" or Upper Cretaceous of previous authors) west of Gaiman are tilted or contorted, while the later beds, in the adjacent cliff, are horizontal or only more gently inclined.

2. On the south side of the valley at "La Angostura," between Gaiman and Dolavon and beginning about one league west of my Section 1, there is a long cliff formed by usually markedly stratified and thin-bedded sands, clays, and tuffs, in the lower part with much chalcedony and gypsum (see Fig. 10). This series shows some irregular gentle folding and small faults, while some blocks of it may be more strongly tilted. It is at about the same altitude as the barren tuffs a-d of Section 1, into which, however, it cannot be traced laterally due to the lack of good intermediate exposures. Frenguelli believes this series to represent the "argiles fissilaires" which, according to widely accepted views, are supposed to be of Cretaceous age where typically developed farther south in Patagonia, to be folded, and to underlie the Tertiary (usually the Casamayor) with angular unconformity. He explains the lateral substitution of this fissile series for the more massive beds near Section 1 by supposing that the former are the upper and the latter the lower parts of one formation which is tilted westward, or with a strong western component, and then planed off at its upper contact so that near Section 1 the lower part underlies the Patagonian and at La Angostura the upper part.

As to (1), the conclusion drawn does not seem to follow from the observed facts. In isolated blocks, where the overlying beds have been eroded off and continuity cannot be established, the Río Chico is sometimes tilted in a way different from that of the upper beds in nearby, but distinct, exposures (Fig. 11). But wherever both occur in one exposure or where the Río Chico is actually visible at the base of the main cliff (as at the Pan de Azúcar), upper and lower series are perfectly parallel so far as the eye can see or instrument surely measure (Fig. 4). The possible conclusions are, then: (a) that an angular conformity exists in some places and not in others in the immediate vicinity and that the upper beds happen to have been eroded away wherever it does exist, (b) that both series or parts of both are folded, more or less parallel to each other and the strongest folding is farther out in the present valley where the upper beds are eroded away, or (c) that there is no real strong folding and that some of the smaller blocks of the lower formations, left outlying by

the retreat of the main cliff, have slumped on the underlying greasy clays. I see no absolutely decisive evidence in favor of any one of these three possibilities, but (a), the only one in accord with previous interpretation, seems to me far the least probable.

As regards (2), it must first be mentioned that the correlation of these beds of La Angostura with the "argiles fissilaires" is highly dubious. I cannot agree that there is any real lithologic resemblance between these

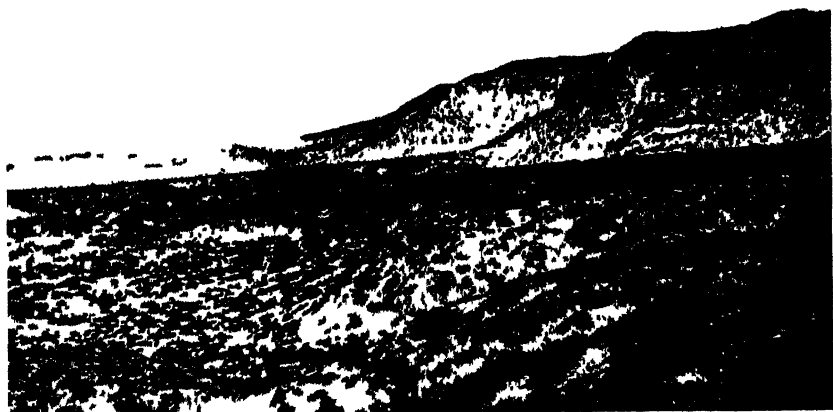


Fig. 11. The north valley wall, near Gaiman Nuevo and a short distance west of Fig. 4.

The cliff is formed by the Casamayor, with Trelew and Patagonian at the top. The foreground is Río Chico, normally nearly horizontal and parallel with the beds of the main cliff, but in some isolated blocks (as in the distance, to the left) tilted.

beds and the "argiles fissilaires" of the Colhué-Huapi, Mazaredo, or Río Descado regions. The one typical rock of the "argiles fissilaires" is an opalized tuff, which is not present at all at La Angostura so far as I saw. No truly fissile clays or, still less sands like those typical of the Angostura series occur in any of the many true "argiles fissilaires" exposures that I have seen. If, as is possible, these beds are of the same age as the "argiles fissilaires," this is in spite of and not evidenced by, their lithologic character. If they are the upper part of series a-d, Section 1,

then they cannot be of "argiles fissilaires" age, as that would put them above tuffs which cannot be older than Casamayor, and the typical "argiles fissilaires" are always below the Casamayor tuffs. The correlation, however, is not very important from the present point of view. It would go too far afield to discuss the matter further here, but it now seems beyond reasonable doubt that the typical "argiles fissilaires" are not Cretaceous but Tertiary and are essentially parallel to the Casamayor wherever both are now known to occur. It is probable that they are



Fig. 12. Part of the fissile series of La Angostura, showing distorted block.

In this case it is obvious that the block is merely a slumped segment of the main cliff and that its distortion is purely superficial and not tectonic. It is believed that this is the true interpretation of other apparently folded exposures where the relationship to unfolded strata cannot be clearly seen and that this condition explains much, perhaps all, of the supposed strong folding in this region and in some other parts of Patagonia.

merely a lithologic facies of Casamayor beds, although this is not yet rigidly proven.

The evidence for folding and angular unconformity from these Angostura strata thus receives no support from analogy with conditions farther south and depends on local observation and especially on the apparent lateral substitution of these for beds of quite different character near Section 1. The two cannot be traced into each other, but in the

poor and small exposures between them the thin-bedded Angostura rocks disappear, and apparently at the same level and within two or three kilometers appear massive barren tuffs. If explainable because of the attitude of the lower beds, this would demand a higher dip than any actually observable. In rather detailed study of this side of the valley we found the dips which can be considered as reasonably persistent to be very low, and not to the west. Except for obviously local disturbances, the dip opposite Trelew and Gaiman was not observed to exceed one half degree, and was generally south or even southeast, not regionally west. Local and not very marked contortions in the Angostura exposures are frequent, as might be expected from their lithologic nature, and there are also many large blocks that have slumped from the cliff (Fig. 12), are hence sometimes more steeply inclined, and might be mistaken for bedrock exposures, but the real regional dip of this formation, also, seemed to us to be extremely small, and not definitely to the west. The relation of the Angostura beds to the more usual sections is not at all clear, but it seems hardly possible that it involves marked folding. As a hypothesis, still very tentative, the thin-bedded series may be a lateral lacustrine facies.

As far as we saw, or the literature indicates, there is no single exposure here on the south side, either, where an angular unconformity can actually be seen. In a series with several distinct erosional breaks, it is to be expected that small angular unconformities exist, but the evidence is still lacking. If they are present, it seems almost certain that the angle involved is less than a degree, which can hardly be considered as typifying a strong early type of folding as contrasted with a gentler, later Tertiary type, in accordance with the views of Windhausen (e.g., 1924), for instance, which have been considered as applicable to this area. Aside from the usual very gentle and local folding and faulting affecting all beds almost equally, as far as can be positively determined, there seems to be a regional dip across the valley around Gaiman approximately to the south, possibly southeast.¹

Assuming that the local correlations between Section 1 and Section 2 here proposed are correct (and I hardly see how any other interpretation can be made on the basis of the new data here mentioned), then the dubious nature of the supposed widespread angular unconformity is also suggested by its being placed at very different levels in different sections, although considered as the same throughout. Near Section 1, it was

¹This is a statement of as much as seems really supported by good evidence in the Gaiman region, and not a generalization. There is strong folding of Tertiary beds as late as Desado in some localities. As far as I know the Patagonian and later formations, however, are never markedly folded or tilted in the meseta region.

supposed to be between the barren beds doubtfully Casamayor and the Trelew, and in Section 2 at the much lower level between the Río Chico and the ?Casamayor.

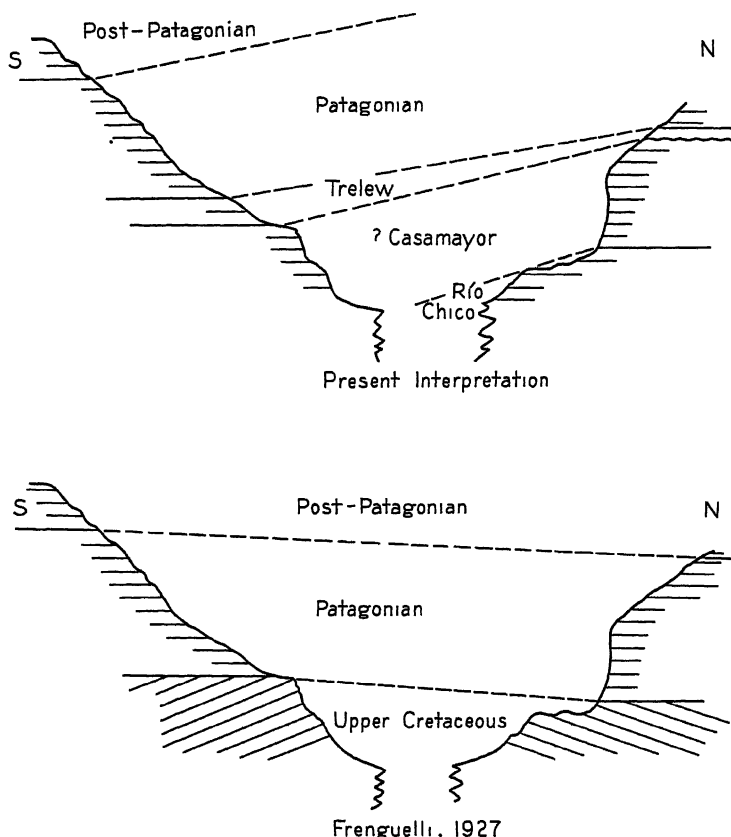


Fig. 13. Diagrammatic sections across the Chubut Valley in the Gaiman region, approximately south to north. The broad valley bottom, without bedrock exposures, is omitted.

Above, interpretation expressed in the present paper. Below, that of Frenguelli, 1927. Frenguelli does not give the section in this form, but the diagram is combined and simplified from his several published sections and is believed to represent his views of 1927 accurately. The correlation lines in the upper diagram do not represent dip, but are steeper (although in the same direction), due to the omission of several miles between the two sections.

The accompanying diagram (Fig. 13) shows the conclusions as to stratigraphic subdivision, correlation, and regional structure here reached, in contrast with the views of Frenguelli—the latter being given because they are recent, most fully documented, and based on such capable field work, and not to single them out for individual criticism.

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ADDENDUM

Since this paper went to press, I have received a paper by Dr. Alfredo Castellanos (Quid Novi? Revista de las Asociaciones de Ex-alumnas y Padres de la Escuela Normal Número 2, Rosario, Argentina, Año II, Núm. 6, 1934), in which he uses the name "Ríochoense" in a sense different from that which I have given to "Río Chico" or "Río-chiquense" in this paper and elsewhere (also recently used in papers by others). As Castellanos cites no previous authority (and I can find none), I presume that a new name is intended, although no definition is given beyond a parenthetical equation with one of Ameghino's names, itself of very dubious value. Castellanos' name is a virtual homonym of mine, which was published before his and with a full definition.

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AFRICAN MUSCIDAE.—II

By C. H. CURRAN

Several African genera are reviewed in this contribution, keys being presented to the species known to belong to them. It should be borne in mind that other described species may belong to each of the genera as now limited and that most of the species described in the genus *Coenosia* probably belong in this genus in the strict sense. However, without specimens it is impossible to decide their position and they have been omitted.

COENOSIA Meigen

I follow Huckett in placing *Caricea* Desvoidy as a synonym of *Coenosia* and therefore consider all species placed in *Coenosia* by Stein in which the posterior tibia bears only two bristles near the middle, their bases approximate, or the anterior bristle arising somewhat before the anterodorsal, as belonging to this genus. Species in which there is only one bristle (anterodorsal) present I do not consider as belonging here, and some species placed in *Caricea* by Malloch are excluded. Despite the fact that I am separating *Coenosia* and *Limosia*, at the present time I am inclined to the belief that they might properly be regarded as a single genus, and that the African species lacking the bristles used for the separation of these and related genera should all be placed in *Coenosia*.

TABLE OF SPECIES

- | | |
|---|-------------------------------|
| 1.—Femora black, the tips sometimes pale. | 2. |
| At least one pair of femora very broadly reddish or yellowish basally. | 11. |
| 2.—Knob of halteres brown. | 3. |
| Knob of halteres yellowish. | 4. |
| 3.—Face whitish pollinose. | <i>praeacuta</i> Stein. |
| Face brownish or brownish-yellow pollinose. | <i>brunneifacies</i> , n. sp. |
| 4.—Wings whitish on the basal half or more, brown apically. | 5. |
| Wings unicolorous or almost so, rarely whitish on basal fourth. | 6. |
| 5.—Paired black abdominal spots confluent and rather poorly defined. | |
| | <i>semifumosa</i> Stein. |
| Paired black abdominal spots widely separated, sometimes indistinct. | |
| | <i>semialba</i> Malloch. |
| 6.—Tibia wholly yellowish. | <i>humilis</i> Meigen. |
| Tibiae mostly brown or black. | 7. |

- 7.—Abdomen cinereous, with paired spots and sometimes a median vitta. 8.
 Abdomen brown, the fourth segment often mostly cinereous, the others with
 broad, broadly interrupted basal fasciae or with cinereous sides. 9.
- 8.—Abdomen of male with median series of brown spots. *tripunctiventris* Malloch.
 Abdomen without median series of brown spots. *semialba* Malloch.
- 9.—Front about half as wide as one eye. *pilifemur* Stein.
 Front more than three-fourths as wide as one eye. 10.
- 10.—Lower squamal lobe twice as long as the upper; arista without pubescence below.
laxifrons, n. sp.
 Lower squamal lobe of female about one-half longer than the upper; arista very
 short plumose. *nestor*, n. sp.
- 11.—Rays of the arista as long as the third antennal segment. *longiseta* Stein.
 Arista very short plumose or pubescent. 12.
- 12.—Cross-veins strongly clouded with brown. *bequaerti*, n. sp.
 Cross-veins not strongly clouded with brown. 13.
- 13.—Third antennal segment blackish. 14.
 Third antennal segment pale yellow. *longitarsis* Stein.
- 14.—Mesonotum with a pair of strong brown vittae extending on to the sides of the
 pale pollinose scutellum, the median vitta linear. *inaequivitta* Malloch.
 Mesonotum and scutellum differently colored. 15.
- 15.—All the coxae yellow, the middle pair rarely darkened toward the outer end. . . 16.
 Middle and posterior coxae usually mostly blackish in ground color. 17.
- 16.—Small species, under 4 mm. in length. *ethelia*, n. sp.
 Large species, about 6 mm. in length. *atroapicata* Malloch.
- 17.—Anterior bristle on hind tibia arising opposite or before the base of the antero-
 dorsal bristle. 19.
 Anterior bristle arising distinctly beyond the base of the anterodorsal. 18.
- 18.—One hair and one bristle above the outer side of the front coxae.
cuthbertsoni, n. sp.
 Several hairs and a fine bristle above the front coxae. *graueri*, n. sp.
- 19.—Mesonotum and abdomen uniformly whitish. 20.
 Mesonotum or abdomen with at least a weak brownish vitta or vittae. 21.
- 20.—Front wholly silvery white in male. *munroi*, n. sp.
 Front with brown or black vitta in male. *burunga*, n. sp.
- 21.—Species over 5 mm. in length. 22.
 Not over 4 mm. in length; abdomen with paired spots and median brown vitta.
(flavipes Adams). *strigipes* Stein.
- 22.—Sides of the scutellum cinereous basally. 23.
 Scutellum brown on its whole width basally, the apex usually cinereous; squamae
 of the male brownish. *rebmanni* Speiser.
- 23.—Mesonotum with a strong median brown vitta extending on to the scutellum or
 with the three vittae only weakly separated. 24.
 Without such markings. 26.
- 24.—Anterior bristle on the posterior tibia arising only a little before the antero-
 dorsal bristle. 25.
 Anterior bristle arising far before the anterodorsal bristle. *calopoda* Bezzi.

- 25.—Anterior femora wholly black..... *burunga*, n. sp.
 Anterior femora black above..... *strigaria*, n. sp.
 26.—Anterior bristle on the posterior tibiae situated far before the anterodorsal
 bristle..... *calopoda* Bezzi.
 Anterior bristle on posterior tibiae situated only a little before the anterodorsal.
leopoldi Curran.

Coenosia praeacuta Stein

STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 568.

Two males, Mulata Mts., Harrar Province, Abyssinia, October 15, 22-25, 1920 (B. Brown); female, Chirinda Forest, Southern Rhodesia, November, 1930 (A. Cuthbertson).

I am not certain that the female belongs with the males since it has a brownish front, but the fact that the face is white pollinose leads me to believe that it is *praeacuta*. The species was originally described from a single male from Abyssinia.

Coenosia brunneifacies, new species

Related to *praeacuta* Stein but with the face and cheeks brown pollinose. Length, 3.5 to 4.5 mm.

MALE.—Front and occiput white, the face and cheeks brown; front scarcely half as wide as one eye, gently widening posteriorly; six pairs of frontals, the upper pair reclinate, and one or two hairs; ocellars long and fine. Occipital hair black. Cheeks half as wide as the third antennal segment. Antennae black, with yellowish-brown reflection from basal view; arista swollen and pubescent on the basal sixth; third antennal segment ending moderately above the vibrissae, its upper apex produced but not acute. Palpi black.

Thorax black, the upper surface silvery white, the scutellum and postnotum more cinereous; acrostical hairs rather strong, in two rows; one or two hairs below the stigmatal bristle, the lower one directed obliquely downward.

Legs black; anterior tibiae with a long, fine bristle behind; anterior bristle on the posterior tibia situated close to the anterodorsal bristle.

Wings tinged with brown. Squamae white. Halteres brown.

Abdomen dull silvery white, without dark markings. Genitalia large, extending obliquely forward, the lobes of the fifth sternite with several long bristles at the base.

FEMALE.—Front wider, brownish, with six pairs of bristles; occiput with cinereous pollen, the middle of the face grayish brown; third antennal segment not produced at the upper apex, the antennae distinctly shorter than in the male. Dorsum of thorax brownish. Abdomen sub-shining, brownish, the segments broadly tinged with gray laterally on the bases, the fourth segment mostly grayish.

Types.—Holotype, male, and two paratypes, males, Addis Abbaba, Abyssinia, August 31, 1920 (B. Brown). Allotype, female, Mount Ninagongo, Belgian Congo, 9700 ft., February 15, 1927 (J. Bequaert).

***Coenosia semifumosa* Stein**

STEIN, 1914, 'Voy. Allaud and Jeann.,' Dipt., p. 136.

Caricea semifumosa MALLOCH, 1922, Ann. Mag. Nat. Hist., X, p. 581.

Two males, Barberton, South Africa, May 21, 1913, and May 16, 1914 (H. K. Munro); male, Barberton, August, 1913 (L. S. Hardenberg).

Described from East Africa and recorded from Willow Grange, Natal, by Malloch. The female is unknown but probably has unicolorous wings and dark thorax and abdomen. The rays of the arista are fully as long as the width of the third antennal segment and it is possible that the two sexes may be associated on this character.

***Coenosia humilis* Meigen**

MEIGEN, 1826, 'Syst. Besch. Eur. Dipt.,' V, p. 220.

Caricea multimaculata ADAMS, Kans. Univ. Sci. Bull., III, p. 205.

Seven males and three females, Barberton, South Africa, May 5, 15, and 17, 1913, and May 17, 1914; male, Pretoria, Transvaal, January 5, 1916; female, Port Elizabeth, South Africa, February 24, 1919 (H. K. Munro); female, Illovo, South Africa, June 8, 1919; female, Premier Mine, South Africa, April 11, 1914 (H. K. Munro); female, Bloemfontein, South Africa, May 30, 1920 (H. E. Irving).

I have examined the type of *multimaculata* Adams and find that it agrees perfectly with a specimen in the collection, which has been marked "compared with type." I find that there is some variation in the color of the front, the white sheen being almost absent in some specimens, and some females have a distinct yellowish-brown tinge. However, I can find no other differences and believe that all the specimens are conspecific.

***Coenosia pilifemur* Stein**

STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 572.

MALLOCH, 1922, Ann. Mag. Nat. Hist., X, p. 581.

Five females, Barberton, South Africa, May 6, 15, 1913, 1915 (H. K. Munro).

A very small species, black, the sides of the abdomen thinly cinereous pollinose, the pollen extending as long triangles on to the dorsum of the first three segments, the fourth segment wholly pale pollinose in the female.

***Coenosia laxifrons*, new species**

Black, the halteres and bases of the tibiae yellowish; wings with strong brown tinge. Length, 4.5 mm.

FEMALE.—Front brown pollinose, about one-third the width of the head at the vertex, gently narrowing anteriorly; four pairs of frontals, the upper pair reclinate;

ocellars long, the postocellars long and divergent. Occiput, cheeks and face cinereous pollinose, the hair and bristles black; cheeks very narrow. Palpi brown. Antennae black, with brownish reflection when viewed from the base; third segment long, acute at upper apex; arista with very short rays on the basal half of the upper surface.

Thorax cinereous pollinose, the dorsum, with the exception of the humeri, brown, the mesonotum with five darker vittae; acrostical hairs in two rows; no hairs surrounding the stigmatal bristle; anterior sternopleural bristle moderately strong.

Legs black, the bases of the tibiae broadly reddish yellow; coxae cinereous pollinose; anterior tibiae with a very long posterior bristle situated before the middle; anterior bristle on the hind tibiae situated opposite the anterodorsal bristle.

Wings with strong brown tinge; squamae cinereous white, the lower lobe twice as long as the upper. Halteres yellow.

Abdomen brown above, cinereous pollinose on the sides, venter, and broad bases of the segments, the pale fasciae more or less distinctly interrupted in the middle, the fourth segment mostly cinereous yellow pollinose with an incomplete median brown vitta.

HOLOTYPE.—Female, Pretoria, Transvaal, January 23, 1921 (H. K. Munro), returned to Mr. Munro.

Coenosia nestor, new species

Black, cinereous white pollinose, the male with brownish abdominal markings, the female with the abdomen mostly brown and the mesonotum with brown tinge; legs black. Length, 3 mm.

MALE.—Front as wide as one eye, black, the orbits cinereous, the triangle surrounding the ocelli brownish yellow; four pairs of frontal bristles, the anterior and third pair strongest, the upper pair rather short and reclinate; ocellars weak; post-ocellars as strong as the ocellars, gently divergent. Occiput, face, and cheeks white pollinose, the bristles black; cheeks wider than the third antennal segment. Palpi brown. Antennae black, the second segment white above; third segment acute at upper apex; arista very short plumose.

Thorax cinereous white pollinose, with brownish tinge on the middle of the dorsum; acrostical hairs in two irregular rows; no hairs surrounding the stigmatal bristle; anterior sternopleural bristle moderately strong.

Legs blackish; coxae whitish pollinose; posterior bristle on front tibia short and rather weak; anterior bristle on posterior tibia opposite the anterodorsal bristle.

Wings cinereous hyaline. Squamae whitish, the lower lobe almost twice as long as the upper. Halteres yellow.

Abdomen cinereous white pollinose, the segments with lateral brownish spots and median vitta that are fused, the dark areas variable in extent but usually covering most of the dorsum with the exception of large lateral rectangles on the bases of the segments. Genitalia large, extending forward almost to the middle of the abdomen.

FEMALE.—Mesonotum, with the exception of the humeri, yellowish brown; bristle on the front tibia stouter and longer; pale abdominal pollen forming interrupted bands on the bases of the segments.

TYPES.—Holotype, male, and allotype, female, Addis Abbaba, Abyssinia, August 31, 1920. Paratypes: two males and three females, Addis Abbaba, July 18, 1919, and August 31, 1920 (Barnum Brown).

Coenosia longiseta Stein

STEIN, 1906, Berlin Ent. Zeitschr., LI, p. 78; 1913, Ann. Mus. Nat. Hung., XI, p. 576.

Caricea longiseta MALLOCH, 1922, Ann. Mag. Nat. Hist., X, p. 582.

Male, Lomagundi, Southern Rhodesia, November, 1928 (A. Cuthbertson); female, Gbanga, Liberia, September, 1926 (J. Bequaert). The species has been previously recorded from Ashanti, Sierra Leone, southern Nigeria, Uganda, Nyasaland and Natal.

Cinereous pollinose, the abdomen with three or four pairs of light brownish spots; legs yellowish, the coxae mostly black in ground color, the apical one or two segments of the tarsi brownish.

Coenosia bequaerti, new species

A large species with reddish-yellow, black-marked legs and dark brown clouds on the cross-veins. Length, 9 mm.

FEMALE.—Head white pollinose, the front brown with whitish orbits, the bristles arising from brown spots; front three-fourths as wide as one eye, its sides gently bowed outward; six pairs of frontals, the upper pair reclinate; ocellars long; post-ocellars long and divergent. Hair black. Cheeks twice as wide as the third antennal segment. Palpi brownish red, with the apex broadly brown. Antennae black, reaching to the lowest third of the face, the third segment sharply rounded at the upper apex, with brownish yellow reflection; second segment whitish pollinose; arista very short plumose, the lower rays not more than half as long as the upper.

Thorax cinereous white pollinose; mesonotum brown pollinose with the broad sides in front of the wings, a pair of median vittae on the anterior fourth and another pair beginning outside the posterior ends of the median pair and extending to the corners of the scutellum, cinereous white; scutellum cinereous with the disc brown. Acrostical hairs short, in three irregular rows anteriorly, numerous and occupying the entire space between the dorsocentrals in front of the scutellum. Several small hairs near the stigmatal bristle; anterior sternopleural bristle long. The pleura have a brown stripe above in front of the wings, the stripe broadening on the mesopleura.

Legs reddish yellow, the tarsi brown with paler bases; anterior femora black on the whole upper surface and on the apical third; middle femora black on the apical third, the posterior pair on the apical fourth; tibiae with faint brownish band near the basal fourth; coxae black, cinereous white pollinose, the tips of the front pair reddish. Posterior bristle on the front tibia long and strong, arising distinctly beyond the middle; anterior bristle on the posterior tibia arising distinctly beyond the antero-dorsal bristle.

Wings cinereous hyaline, the veins brown; anterior cross-vein surrounded by a round, dark brown spot, the posterior cross-vein bordered with brown. Squamae white. Halteres yellow.

Abdomen cinereous pollinose; each segment with a pair of large brown spots and a narrow median vitta.

HOLOTYPE.—Female, Mount Ninagongo, Belgian Congo, 9700 ft., February 15, 1927 (J. Bequaert).

***Coenosia longitarsis* Stein**

STEIN, 1900, Ent. Nachr., XXVI, p. 323.

Caricea longitarsis MALLOCH, 1922, Ann. Mag. Nat. Hist., X, p. 587.

Described originally from Europe and recorded from Natal by Malloch.

***Coenosia inaequivitta* Malloch**

Caricea inaequivitta MALLOCH, 1922, Ann. Mag. Nat. Hist., X, p. 584.

Described from Kenya Colony, East Africa. I have not seen the species.

***Coenosia ethelia*, new species**

A small species with yellow legs, including the coxae. Length, 3.5 mm.

FEMALE.—Front about half as wide as one eye, the vitta black with white sheen; four pairs of frontals, the second pair weak, the upper pair reclinate; ocellars long; postocellars long and divergent. Head white pollinose, the hair and bristles black. Cheeks as wide as the third antennal segment. Palpi brown. Antennae black, silvery in some views, the third segment with sharp upper apex; arista pubescent above.

Thorax cinereous pollinose, the mesonotum with a distinct median vitta and indistinct, yellowish-brown sublateral vittae. Acrostical hairs short and paired. No hairs surrounding the stigmal bristle. Anterior sternopleural weak.

Legs reddish yellow; bristle on the posterior surface of the anterior tibiae situated at the middle and more than half as long as the tibia, the anterior bristle on the posterior tibiae situated opposite the anterodorsal bristle.

Wings cinereous hyaline. Squamae white, the lower lobe more than twice as long as the upper. Halteres yellow.

Abdomen cinereous pollinose, each segment with a brown median vitta and lateral spots, those on the fourth segment quite weak, the spots on the first segment rather diffuse.

TYPES.—Holotype, female, Pretoria, Transvaal, January 17, 1916, and paratype, female, Barberton, South Africa, May 15, 1913 (H. K. Munro). The type has been returned to Mr. Munro.

***Coenosia atroapicata* Malloch**

Caricea atroapicata MALLOCH, 1922, Ann. Mag. Nat. Hist., X, p. 586.

Female, Chirinda Forest, Southern Rhodesia, November, 1930; female, Inyanga, Southern Rhodesia, November, 1933 (A. Cuthbertson).

Both specimens have the coxae entirely yellowish, a character not mentioned in the original description. The brown abdominal spots are transverse, irregular in outline, but more or less rectangular.

***Coenosia cuthbertsoni*, new species**

Cinereous, the abdomen with median vitta and lateral brown spots. Length, 4 to 5.25 mm.

MALE.—Head cinereous pollinose, face white, the frontal vitta black. Front three-fourths as wide as one eye, the sides gently bowed outward; four pairs of frontals,

only the anterior pair strong, the upper pair reclinate; ocellars short; postocellars divergent. Hair and bristles black. Cheeks one-half wider than the third antennal segment. Palpi brownish red, with the apex broadly black. Antennae black, the second segment silvery above; third segment short, the upper apex not acute; upper rays of the arista more than half as long as the width of the third antennal segment, the lower rays very short.

Thorax cinereous pollinose, the mesonotum with a distinct median vitta, weak sublateral vittae and indications of dorsocentral brown vittae. Acrostical hairs short, in two rows. At most a single hair near the stigmatal bristle; anterior sternopleural weak.

Legs reddish yellow, the coxae black, cinereous pollinose, the anterior pair mostly reddish in ground color; anterior femora with the upper surface broadly black, the posterior four with brown preapical spot above. Posterior bristle on the front tibia short, arising at the middle; anterior bristle on the posterior tibia arising distinctly beyond the anterodorsal and shorter than it; apical tarsal segment somewhat brownish.

Wings cinereous hyaline. Squamae white. Halteres yellow.

Abdomen oval, with median brown vitta and more or less orbicular or oval spots on each segment, those on the first segment weak. Genitalia rather small, the fifth sternite large.

FEMALE.—Frontal vitta with yellowish-brown tinge, the bristles arising from black spots; bristle on front tibia moderately long; first abdominal segment without distinct spots.

TYPES.—Holotype, male, Salisbury, Southern Rhodesia, April, 1927 (No. 105, A. Cuthbertson); allotype, female, Durban, Natal.

Coenosia graueri, new species

Black, with cinereous pollen and mostly reddish yellow legs; wings with brownish tinge anteriorly. Length, 6 mm.

MALE.—Head cinereous pollinose, the front strongly tinged with yellow; frontal vitta partly black in some views. Front about half as wide as one eye, gently widening above; five pairs of frontals, two of them hair-like, the upper pair reclinate; ocellars moderately long; postocellars divergent. Hair black. Cheeks about as wide as the third antennal segment. Palpi reddish brown. Antennae black, the second segment white above; apex of third segment angular above; arista long pubescent.

Thorax cinereous pollinose, with five brownish vittae that tend to fuse, none of them very conspicuous; acrostical hairs fine, in two rows; several hairs surrounding the fine stigmatal bristle; anterior sternopleural bristle weak or absent.

Legs reddish yellow; the posterior four coxae, broad upper surface of the anterior femora, the apical fourth or less of the posterior four femora on the upper half, and all the tarsi black; femora with abundant fine hair on the lower half; posterior bristle on the front tibia half as long as the tibia; anterior bristle on the posterior tibia long, situated distinctly beyond the anterodorsal.

Wings cinereous hyaline, lightly tinged with brown in front. Squamae white. Halteres pale yellow.

Abdomen cinereous pollinose, the dorsum of the second and third segments with a brown band occupying more than the apical half of each segment and extending

forward in the middle, the fourth segment with the middle broadly brown on most of its length. Genitalia rather small. Under side of the abdomen with soft hair medianly.

HOLOTYPE.—Male, Tanganyika, 1910 (Grauer), in Vienna Museum of Natural History

***Coenosia munroi*, new species**

A small, cinereous pollinose species with white face and front. Length, 2.5 to 3 mm.

MALE.—Head silvery-white pollinose, the occiput cinereous except along the orbits. Front three-fourths as wide as one eye, with three pairs of orbitals, the upper pair reclinate; ocellars long and fine; postocellars weak. Hair black. Cheeks about one-half wider than the third antennal segment. Palpi brown. Antennae rather small, black, silvery-white pollinose; third segment narrow, the apex rounded; arista pubescent above and below.

Thorax cinereous pollinose; acrostical hairs in two irregular rows; no hairs surrounding the stigmatal bristle; anterior sternopleural hairlike.

Legs reddish yellow; anterior femora black, the posterior four black on the apical fourth or more; tarsi black, the tibiae variable, usually brownish with the base and apex broadly yellow, the posterior pair usually brown with a paler median band, the anterior four sometimes yellowish with very broad subbasal brown bands. Posterior bristle on the front tibia long and slender; anterior bristle on the posterior tibia situated slightly before the anterodorsal.

Wings cinereous hyaline. Squamae whitish. Halteres reddish yellow.

Abdomen cinereous or cinereous white pollinose. Genitalia long, mostly black. Fifth sternite shining black.

TYPES.—Holotype, male, and paratypes, five males, Barberton, South Africa, May 15, 17, and 22, 1913 (H. K. Munro). The holotype has been returned to Mr. Munro.

***Coenosia burunga*, new species**

Cinereous white pollinose, the legs mostly black. Length, 5 to 6 mm.

MALE.—Head white pollinose, the frontal vitta black; triangle surrounding the ocelli with yellow tinge. Front about half as wide as one eye, gently widening above; four pairs of frontals and one or two pairs of bristly hairs; ocellars moderately short; postocellars fine. Hair black. Cheeks one-half wider than the third antennal segment. Palpi brown. Antennae black, the second segment white above, the third angulate at upper apex, short, with silvery reflection in some lights; arista with short rays above, pubescent below.

Thorax cinereous white pollinose, without dark markings; acrostical hairs weak, sparse, in two rows; one or two hairs adjacent to the stigmatal bristle; anterior sternopleural weak.

Legs black; middle femora with the broad base yellowish, the posterior pair yellow on a little more than the basal half; tibiae brownish with the bases broadly yellow, the anterior pair paler in color than the others. Posterior bristle on the anterior tibia long and fine. Anterior bristle on the posterior tibia fine, situated distinctly before the anterodorsal.

Wings cinereous hyaline with the base broadly white. Squamae white. Halteres reddish yellow. Abdomen cinereous white, the fifth sternite less densely pollinose than the tergites; genitalia rather small.

FEMALE.—Very different in the color of the thorax and abdomen. Front a little wider. Mesonotum with three broad brown vittae, the median one extending as a triangle to the apex of the scutellum; legs colored as in the male but the posterior bristle on the front tibia, and the anterior bristle on the hind tibia, long and strong; wings wholly cinereous hyaline; abdomen cinereous pollinose, with a median vitta and paired, rather orbicular brown spots on the second to fourth segments.

TYPES.—Holotype, male, and allotype, female, Burunga, Belgian Congo (J. Bequaert).

Despite the marked difference in coloration I have no doubt about the relationship of the two sexes.

Coenosia strigipes Stein

Coenosia cingulipes STEIN, 1897, Wien. Ent. Zeitg., XVI, p. 92 (not Zetterstedt).

Caricea flavipes ADAMS, 1905, Kans. Univ. Sci. Bull., III, p. 206 (not Williston).

Coenosia strigipes STEIN, 1916, Arch. für Naturg., LXXXI, Abt. A, Heft 10, p. 215 (1915).

Caricea strigulipes MALLOCH, 1922, Ann. Mag. Nat. Hist., X, p. 587.

Male and two females, Barberton, South Africa, May 6, 15, 22, 1913; male, East London, Cape Province, February 15, 1919; female, East London, March 31, 1925 (H. K. Munro).

Stein originally confused this species with *cingulipes* Zetterstedt and described it under this name, later changing it to *strigipes*. I have compared specimens with the type of *flavipes* Adams and find that the specimens agree with the description of *strigipes*. The use of *strigulipes* by Malloch was an error, the reference being to *strigipes*.

Coenosia rebmanni Speiser

Coenosia fumipennis STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 575.

Caricea fumipennis MALLOCH, 1922, Ann. Mag. Nat. Hist., X, p. 583.

Seven males and four females, Burunga, Belgian Congo (J. Bequaert).

The color of the femora varies considerably. The anterior femora may be all black or rather extensively reddish yellow on the lower half basally; the middle femora may be yellowish only on the basal fifth of the under surface or on more than the basal half below; the posterior femora may be reddish yellow on the basal three-fourths except above, or on only the basal third. One specimen from Tanganyika (Grauer) is evidently related to *rebmanni* but has the posterior femora reddish yellow except for a brown band occupying the apical fifth.

My reference to *rebmanni* has been mislaid and I have failed to locate either the notation or the publication in which the name was proposed.

***Coenosia calopoda* Bezzi**

BEZZI, 1908, Bull. Soc. Ent. Ital., XXXIX, p. 119.

Caricea calopoda MALLOCH, 1922, Ann. Mag. Nat. Hist., X, p. 586.

Female, Behungi, Uganda, April 4, 1927 (J. Bequaert); female, northwest Tanganyika, 1910 (Grauer); male, Kibati, Belgian Congo, March 28, 1927 (J. Bequaert)

The male differs rather markedly from the female in lacking brown markings on the thorax and abdomen and in having the pollen more whitish.

MALE.—Front half as wide as one eye, the vitta black, cinereous from anterior view, bisected on the upper half by the cinereous triangle surrounding the ocelli; five or six pairs of frontals; palpi brown. Antennae black, the second segment white above, the third thinly cinereous pollinose.

Thorax cinereous white pollinose, the acrostical hairs in two irregular rows; several hairs surrounding the fine stigmatal bristle; anterior sternopleural bristle absent.

Legs reddish yellow, the tarsi black; anterior femora broadly black above, the posterior four black on the apical third or less; femora with rather thick hair on the lower half. Posterior bristle on the anterior tibia fine; anterior bristle on the posterior tibia situated far before the anterodorsal bristle.

Wings cinereous hyaline, becoming rather whitish basally. Squamae white. Halteres yellow.

Abdomen uniformly cinereous pollinose, with rather thick hair below.

***Coenosia strigaria*, new species**

Cinereous pollinose, the mesonotum with three brown vittae which may be more or less fused, the abdomen with median vitta and paired spots on the second and third segments. Length, 6 mm.

FEMALE.—Head cinereous pollinose, the frontal vitta black with brown tinge in some lights, the triangle surrounding the ocelli brown. Front three-fifths as wide as one eye; five or six pairs of frontals, two or three of them weak, the upper pair reclinate, ocellars rather short. Hair black. Cheeks wider than the third antennal segment. Palpi shining brown. Antennae black, thinly cinereous pollinose, the second segment white above; third segment sharply rounded at the upper apex; arista very short plumose on the basal third, the lower rays not half as long as the upper.

Thorax with three brown dorsal vittae which may be more or less fused, the median one extending over the scutellum. Acrostical hairs in two irregular rows; a few hairs surrounding the stigmatal bristle; anterior sternopleural bristle weak.

Legs reddish yellow, the tarsi black; anterior femora black above, the middle pair black on the apical third, the hind pair on the apical fourth. Posterior bristle on the front tibia long and strong, the anterior bristle on the posterior tibia situated distinctly before the anterodorsal bristle.

Wings cinereous hyaline. Squamae white. Halteres pale yellow.

Abdomen cinereous pollinose, with a narrow median vitta and paired brown spots on the second and third segments.

Types.—Holotype, female, and paratype, female, western Tanganyika, 1910 (Grauer), the former in the Vienna Museum of Natural History.

***Coenosia leopoldi* Curran**

Caricea leopoldi CURRAN, 1929, Rev. Zool. Bot. Afr., XVII, p. 247.

I have seen only the type series from the Belgian Congo.

XENOCOENOSIA Malloch

I am assigning to this genus a species that agrees with the type species of *Xenocoenosia* in having only a single bristle on the median half of the posterior tibiae but lacking the posterior preapical bristle on the hind femora. Hockett, in his revision of the American species, united *Xenocoenosia* and *Neodeziopsis* on the basis that both possess a row of three preapical bristles on the upper half of the posterior femora. If we follow Hockett the African species would probably be considered as belonging to *Limosia* Desvoidy (*Coenosia* authors) but I follow Malloch in separating *Xenocoenosia* on the arrangement of the tibial bristles. It is possible that a new genus should be erected for the species before me or that *Coenosia* and *Limosia* should be united, without even sub-generic rank for the latter.

Malloch has described *Coenosia xenia*, a species rather similar to the form before me, but differing in the color of the abdomen and legs.

TABLE OF SPECIES

Anterior femora very broadly yellow basally on the whole surface; abdomen brown above, the bases of the segments more or less cinereous. *africa*, n. sp.
Anterior femora black above on their whole length; abdomen cinereous, with median brown vitta and lateral spots. *xenia* Malloch.

***Xenocoenosia africa*, new species**

Black, with brown and cinereous pollen; femora yellow with the apices broadly black. Length, 6.5 to 8 mm.

Male.—Head thickly cinereous pollinose, the front yellowish brown, with the frontal vitta black, divided on the upper half by a cinereous triangle extending forward from the vertex; from anterior view the front appears wholly yellowish-brown pollinose; four or five pairs of frontals, the median pair longest, the upper pair reclinate, the one or two pairs behind the anterior pair weakest; ocellars long. Hair and bristles of the occiput and oral margin black. Cheeks about as wide as the third antennal segment; parafacials linear. Proboscis and palpi brown. Antennae black, the apex of the second segment sericeous above; third segment not sharply angulate at upper apex; arista rather long pubescent above and below on the basal half or more.

Mesonotum brownish pollinose, the sides cinereous; dorsocentrals 1-3; acros-

tical hairs short, paired. Scutellum brown pollinose with the margin cinereous toward the lower edge. Pleura cinereous pollinose; four sternopleurals arranged in a triangle, three in the posterior row.

Coxae brown, cinereous pollinose, the anterior pair yellowish with brown stains, sometimes mostly brownish in ground color. Femora yellow, the apical third to one-half black, the upper surface more extensively black than the lower; tibiae and tarsi blackish, the anterior tibiae reddish brown, all with the bases broadly yellowish. Posterior femora with two preapical bristles above, none in front or behind. Anterior tibiae with a long, fine, posterior bristle; middle tibiae with shorter, coarser posterior bristle and a weak anterior bristle near the middle; posterior tibiae with a long antero-dorsal bristle situated near the middle, the preapical dorsal bristle situated rather far before the apex.

Wings pale brown; squamae white; halteres pale yellow.

Abdomen black, brown pollinose above, the sides and venter with cinereous pollen; base and apex of the abdomen and indistinct basal fasciae on the second to fourth segments cinereous pollinose. Bristles on the sides and apex of the abdomen long, the fourth segment with a row of rather fine marginals surrounding the hypopygium. Genitalia brown.

FEMALE.—The legs are usually a little less extensively black and the genital segments are yellowish.

TYPES.—Holotype, male, allotype, female, and twelve paratypes of both sexes, northwest Tanganyika, 1910 (Grauer), the types in the Vienna Museum of Natural History.

***Xenocoenosia xenia* Malloch**

Coenosia xenia MALLOCH, 1922, Ann. Mag. Nat. Hist., X, p. 585.

Described from Natal. I have not seen the species.

DICHAETOMYIA Malloch

MALLOCH, 1921, Ann. Mag. Nat. Hist., VII, p. 163.

This genus is well represented in Africa but it is impossible at present to determine the number of species referable to it since most of them have been described in other genera. It is probable that several other described species will be found to belong here. The following key includes all of those known to me.

TABLE OF SPECIES

- 1.—Four postsutural dorsocentrals, the anterior two pairs sometimes weak 2.
Two or three pairs of strong postsutural dorsocentrals 5.
- 2.—Mesonotum reddish in ground color, with two black vittae 3.
Mesonotum black or reddish without black vittae 4.
- 3.—The black vittae are overlaid with white pollen *magiei* Malloch.
The black vittae are not conspicuously white pollinose from posterior view.
phasiaeformis Stein.
- 4.—Sides of the scutellum bare below the marginal bristles *devia*, n. sp.
Sides of the scutellum setose to the lower edge *liberia*, n. sp.

- 5.—Femora partly or wholly black.....6.
Femora wholly reddish or yellowish.....8.
- 6.—Anterior tibia with a posterior bristle near the middle.....7.
Anterior tibia without bristles except apically.....*conformis*, n. sp.
- 7.—Front of male about one-third of the head-width.....*latifrons* Malloch.
Front of male not over one-fifth as wide as the head.....*devia*, n. sp.
- 8.—Tibiae brown; tarsi black.....9.
Tibiae reddish or yellowish.....10.
- 9.—Squamae whitish with narrow blackish border.....*fasciculifera* Stein.
Squamae yellowish.....*fuscitibia* Stein.
- 10.—Palpi black.....11.
Palpi yellow.....13.
- 11.—Mesonotum black with three pale pollinose vittae.....12.
Mesonotum thinly, evenly pollinose (Java! Africa?).....*apicalis* Stein.
- 12.—Humeri yellow.....*quadrata* Wiedemann.
Humeri not yellow.....*polita* Malloch.
- 13.—Anterior tibiae without a posterior bristle.....*pallidula*, n. sp.
Anterior tibiae with a posterior bristle near the middle.....*munroi*, n. sp.

Dichaetomyia macflei Malloch

MALLOCH, 1930, Ann. Mag. Nat. Hist., V, p. 479.

A reddish-yellow species from northern Nigeria. The mesonotum bears two black vittae overlaid with white pollen. The anterior tibiae bear a bristle on the posterior surface near the middle and the parafrontals are brownish yellow. Only the female is known.

Dichaetomyia phasiaeformis Stein

Mydaea phasiaeformis STEIN, 1906, Berl. Ent. Zeitschr., LI, p. 36 (Cameroon).

Allauadinella phasiaeformis STEIN, 1919, Arch. für Naturg., LXXXIII, Heft 1, p. 126.

MALLOCH, 1925, Ann. Mag. Nat. Hist., XVI, p. 363 (Uganda).

I have not seen this species which is similar to the preceding, but is a little larger and lacks the white pollen over the two black mesonotal vittae.

Dichaetomyia latifrons Malloch

MALLOCH, 1928, Ann. Mag. Nat. Hist., I, p. 468.

Originally described from Uganda.

A black species with yellowish-brown wings and shining abdomen, the mesonotum rather thinly cinereous pollinose and black vittate. In the male there are only two strong postsutural dorsocentrals, the anterior two pairs being very small or absent.

***Dichaetomyia devia*, new species**

Similar in appearance to *latifrons* Malloch but the front is less than one-sixth the width of the head; shining black, the thorax thinly pollinose; tibiae reddish yellow. Length, 6.5 to 8 mm.

MALE.—Eyes separated by a distance greater than the length of the ocellar triangle, one pair of strong bristles immediately above the antennae, the others weak, the upper pair reclinate, the intermediate bristles hairlike; parafrontals with silvery pollen; ocellars long and strong; verticals not differentiated. Face, occiput and cheeks with cinereous pollen, that on the face rather silvery; hair black. Proboscis and palpi blackish. Antennae blackish, the incisure between the second and third segments broadly reddish; arista with long rays.

Thorax black or dark brown, rather thinly pale pollinose and weakly bivittate, the dark vittae narrow. Acrosticals 0-1; dorsocentrals 2-2, the anterior two pairs of postsutural dorsocentrals quite weak and not greatly longer than the surrounding hair, the posterior two pairs strong; sternopleurals 2-1; two pairs of marginal scutellars; prealar bristle very weak. The pollen on the disc of the mesonotum is more or less strongly tinged with brown.

Legs black; tibiae and tarsi reddish yellow, the tarsi becoming blackish apically; tips of the femora reddish; anterior tibiae with a median posterior bristle.

Wings strongly tinged with brown; base of third vein with or without a few setulae below. Squamae pale brown, with darker border and grayish fringe. Halteres yellow, with blackish knob.

Abdomen shining black; third and fourth segments each with a row of marginals, the fourth with a row of discals.

FEMALE.—Front about one-fourth the width of the head; two pairs of strong and two pairs of weak frontals; verticals long and strong. Dark mesonotal vittae more conspicuous and moderately wide; three pairs of postsutural dorsocentrals; wings quite brown in front.

TYPES.—Holotype, male, Gbanga, Liberia, September, 1926. Allotype, female, Banga, Liberia, October, 1926. Paratypes: male, Memeh Town, Liberia, August 29, 1926 (J. Bequaert); male and female, northwest Tanganyika, 1910 (Grauer). The specimens from Tanganyika are in the Vienna Museum of Natural History.

***Dichaetomyia liberia*, new species**

Related to *latifrons* Malloch but readily distinguished by having the sides of the scutellum setulose to the lower edge. Dull rusty reddish, the abdomen blackish on the apical half. Length, 6.5 to 7 mm.

MALE.—Head black, white pollinose, the facial ridges and sometimes the depression reddish in ground color. Front a little wider than the width of the ocellar triangle, the black frontal vitta twice as wide as either parafrontal and appearing white from anterior view; three or four pairs of frontal bristles on the anterior third and several hairs between them and the ocellar triangle; ocellars long; verticals not developed. Cheeks narrow, black-haired. Parafacials very narrow. Palpi reddish brown. Antennae reddish yellow, the third segment mostly brown; arista brown long plumose. Eyes with the facets slightly enlarged in front.

Thorax rusty reddish, paler on the sides, the mesonotum rather thinly cinereous

white pollinose and with four narrow, not conspicuous bare vittae, the median pair strongly broadened posteriorly; usually a brown spot below the infra-alar bulla. Hair black. Dorsocentrals 2-4, the anterior presutural and two anterior postsutural bristles weak; anterior intra-alar absent, the prealar short; two pairs of marginal scutellars, the scutellum haired on its lower edge; sternopleurals 1-2.

Legs reddish, the tarsi somewhat darker; middle femora with only the preapical bristles, the posterior pair with only two preapical anteroventrals. Anterior tibiae with a median posterior bristle; middle tibiae with two posterior bristles; posterior tibiae with one or two posterodorsal, one anterodorsal and one or two anteroventral bristles.

Wings with strong luteous tinge; fourth vein moderately curved forward apically; stem of second and third veins with two or three setulae below. Squamae yellowish cinereous. Halteres yellow.

Abdomen rusty reddish, the third and fourth segments shining blackish-brown, the base of the third sometimes reddish laterally. Venter reddish with the apex brown. Hair black. Third and fourth segments each with a row of marginals, the fourth with a row of discals, the third with two on either side.

Types.—Holotype, male, Kakatown, Liberia, August 20, 1926. Paratypes: male, Monrovia, Liberia, 1926, and Du River Camp No. 3, Liberia (J. Bequaert).

This species resembles *Spilogaste analis* Stein but the tarsi are not black.

***Dichaetomyia conformis*, new species**

Related to *latifrons* Malloch but the anterior tibiae bear a median bristle on the posterior surface, the abdomen is pale, etc. Length, about 6.5 mm.

Male.—Head black, white pollinose, the facial ridges reddish in ground color. Front narrower than the width across the ocellar triangle; four pairs of frontals on the anterior third and a pair of hairs in front of the ocelli; ocellars long. Cheeks narrow, black-haired. Parafacials very narrow. Palpi brown. Antennae brown, the apex of the second segment and base of the third reddish. Eyes with slightly enlarged facets anteriorly.

Thorax black, cinereous pollinose, with four weak brownish vittae; humeri yellow, the scutellum and sometimes the sides of the mesonotum brownish. Hair black. Dorsocentrals 2-3; anterior intra-alar long; prealar well developed; three pairs of marginal scutellars, the intermediate pair weak; sides of the scutellum bare; sternopleurals 1-2.

Legs brown; tibiae yellow. Middle femora with one or two long bristly hairs below near the base; posterior femora with two long posteroventral fine bristles on the basal half and with a row of seven or eight on the whole anteroventral surface. Anterior tibiae without bristles near the middle; middle tibiae with two posterior bristles; posterior tibiae with two weak posterodorsal, one anterodorsal, and two anteroventral bristles.

Wings rather strongly tinged with luteous; fourth vein gently curved forward apically; about five setae on the basal part of the third vein. Squamae luteous, with brown border. Halteres brownish yellow.

Basal two abdominal segments rusty reddish-yellow, the apical two, and the apex of the third in the middle, brownish or ferruginous, the fourth broadly reddish

apically. Venter yellow on the basal half, brownish apically; first sternite with two or three blackish setulae on either side. Hair black; third and fourth segments each with a row of marginals and on either side with two or three discals.

FEMALE.—Front with parallel sides, the parafrontals narrow, cinereous white pollinose; frontal vitta dull reddish; four or five pairs of frontals, the anterior and posterior pair long and strong. Humeri pale yellow. Third abdominal segment with only one lateral discal.

TYPES.—Holotype, male, Paiata, Liberia, October, 1926; allotype, female, Du River Camp No. 3, Liberia, 1926 (J. Bequaert).

Dichaetomyia fasciculigera Stein

Mydaea fasciculigera STEIN, 1910, Proc. Linn. Soc. London, XIV, p. 153.

MALLOCH, 1921, Ann. Mag. Nat. Hist., VIII, p. 420.

This species is known only from the Seychelle Islands.

Dichaetomyia fuscitibia Stein

Spilographa fuscitibia STEIN, 1906, Berl. Ent. Zeitschr., LI, p. 51.

MALLOCH, 1921, Ann. Mag. Nat. Hist., VIII, p. 421.

Originally described from Cameroon and recorded from Ashanti by Malloch.

Dichaetomyia apicalis Stein

Spilographa apicalis STEIN, 1904, Tijd. v. Ent., XLVII, p. 103.

MALLOCH, 1921, Ann. Mag. Nat. Hist., VIII, p. 421.

Stein described this species from Java. Malloch records it from Cameroon.

Dichaetomyia quadrata Wiedemann

Aniomyia quadrata WIEDEMANN, 1824, 'Anal. Ent.,' p. 42 (Java).

Aniomyia quadrata WIEDEMANN, 1830, 'Ausser. Zweifl.,' II, p. 428 (Java).

Spilogaster lineata STEIN, 1904, Tijd. v. Ent., XLVII, p. 102 (Java).

Spilogaster lineata STEIN, 1906, Berl. Ent. Zeitschr., LI, p. 51.

Female, Impamputo, Portuguese, East Africa, February 20, 1925 (C. B. Hardenberg); female, Lissalla, Congo, December 26, 1926; male and female, Du River Camp No. 3, Liberia; female, Memeh Town, Liberia, August 29, 1926; female, Lenga Town, Liberia, August 15, 1926 (J. Bequaert); two males, Balla Balla, Southern Rhodesia, January, 1933 (A. Cuthbertson).

Superficially this species resembles *conformis*, new species, but the femora are wholly pale and the mesonotum is more strongly vittate. The scutellum is haired on the sides, the anterior tibiae lack median bristles, the fourth vein is only a little curved forward and the abdomen is mostly rusty yellowish.

***Dichaetomyia polita* Malloch**

MALLOCH, 1921, Ann. Mag. Nat. Hist., VII, p. 163.

MALLOCH, 1921, Ann. Mag. Nat. Hist., VIII, p. 420.

Originally described from British East Africa and later recorded from Ashanti.

Malloch originally described the shining black form but later indicated that the species is variable in color, sometimes being rusty reddish with vittate mesonotum and the apical half of the abdomen black.

***Dichaetomyia pallidula*, new species**

Palpi yellow; head black; thorax and abdomen rusty reddish-yellow; sides of the scutellum bare. Length, 7.5 mm.

FEMALE.—Head black, cinereous white pollinose, the facial ridges and depression reddish in ground color. Front narrower than either eye, gently narrowing above; frontal vitta appearing white from anterior view; parafrontals narrow; four pairs of strong frontals and a row of setulae outside them; ocellars long. Verticals and outer verticals strong. Cheeks narrow, black-haired. Parafacials tapering below. Palpi reddish yellow. Antennae pale orange; the third segment and arista mostly brown.

Thorax rusty yellowish, thinly white pollinose, the mesonotum rusty reddish and with four bare vittae. Three pairs of postsutural dorsocentrals; anterior intra-alar long; prealar strong; four pairs of marginal scutellars, the basal and subapical pair weak; sides of scutellum bare; sternopleurals 1-2. Hair black, yellow on the prosternum.

Legs reddish yellow, the tarsi darkened apically. Posterior femora with four anteroventral bristles on the apical fourth; anterior tibiae without median bristles; middle tibiae with two posterior bristles, the posterior tibiae with three posterodorsal, one anterodorsal and two anteroventrals.

Wings cinereous hyaline, with slight yellowish tinge; fourth vein slightly curved forward apically; third vein bristled below half way to the small cross-vein. Squamae brownish yellow, the halteres pale orange.

Abdomen rusty yellowish, broadly paler basally, dulled with brownish yellow pollen. Third and fourth segments each with a row of marginals, the fourth with a row of discals, the third with two or three on either side. Hair black.

TYPES.—Female, Port Shepstone, Natal, July 17, 1917 (H. K. Munro), returned to Mr. Munro; paratype, female, Salisbury, Southern Rhodesia, June 14, 1932 (A. Cuthbertson).

The latter specimen has a large (macrottype) white egg protruding from the ovipositor. Several specimens of *Dichaetomyia* I have seen were taken at excrement.

***Dichaetomyia munroi*, new species**

Apparently related to *pallidula*, new species, but rather brown in color and with a strong posterior bristle at the middle of the front tibiae. Length, 7 mm.

MALE.—Head black, cinereous pollinose, the parafrontals and parafacials silvery; facial ridges reddish in ground color. Front narrower than the width of the ocellar

triangle, the black frontal vitta appearing cinereous from anterior view; three pairs of strong frontals anteriorly, two or three hairs adjacent to them and two pairs of short hairs near the ocellar triangle; ocellars long. Cheeks almost one-sixth as wide as eye-height, black-haired, rather brownish pollinose. Parafacials very narrow. Palpi reddish yellow. Antennae yellowish, the third segment and arista mostly brown.

Thorax rusty reddish, with reddish-brown pollen, the pleura mostly brownish gray pollinose; mesonotum, from anterior view, with a broad, ferruginous median vitta and traces of narrow vittae along the lines of the bristles; from posterior view appearing reddish brown with three rather narrow yellowish vittae. Three pairs of postsutural dorsocentrals; anterior intra-alar long, the prealar not one-fourth as long as the supra-alar; two pairs of marginal scutellars and indications of two others, the sides of the scutellum haired almost halfway to the lower edge; sternopleurals 1-2. Hair wholly black.

Legs reddish, the tarsi brownish apically. Middle femora with four long, fine ventral bristles on the basal half; posterior femora with five long anteroventral bristles on the apical third and one or two on either side basally. Anterior tibiae with a very strong posterior bristle near the middle, the middle tibiae with two posterior bristles; posterior tibiae with a weak posterodorsal bristle, a strong anterodorsal and one or two weak anteroventral bristles.

Wings with strong luteous tinge; fourth vein slightly curved forward apically; third vein with three or four setulae basally. Squamae yellowish cinereous, with brown border. Halteres pale orange.

Abdomen with the basal segment and very large, basal triangles on the sides of the second, yellowish in ground color, otherwise blackish, the whole overlaid with thick yellowish-brown pollen. Hair wholly black. Third and fourth segments each with a row of erect marginals, the second with two or three laterally, the fourth also with a row of discals behind the middle; second and third segment with two or three lateral discals.

Types.—Holotype, male, Elliot, South Africa, May 11, 1924 (H. K. Munro); returned to Mr. Munro. Allotype, female, Gwelo, Southern Rhodesia, May 30, 1932. Paratypes: female, Balla Balla, Southern Rhodesia, March, 1931 (A. Cuthbertson); and female, northwest Tanganyika (Grauer).

SYNONYMY

- Dichaetomyia* (*Macrozanthomyia*) *celosia* Malloch. See *Panaga*.
Dichaetomyia (*Macrozanthomyia*) *distanti* Malloch. See *Panaga*.
Dichaetomyia (*Macrozanthomyia*) *fasciventris* Malloch. See *Panaga*.
Dichaetomyia (*Macrozanthomyia*) *immaculiventris* Malloch. See *Panaga*.
Dichaetomyia (*Panaga*) *limbipennis* Curran. See *Panaga*.
Dichaetomyia *lineata* Stein = *quadrata* Wiedemann.
Dichaetomyia (*Macrozanthomyia*) *maculiventris* Malloch. See *Panaga*.
Dichaetomyia (*Macrozanthomyia*) *obscuritarsis* Malloch. See *Panaga*.
Dichaetomyia *pallens* Curran. See *Panaga*.

PANAGA Curran

CURRAN, 1928, Bull. Amer. Mus. Nat. Hist., LVII, p. 353, as a subgenus of *Dichaetomyia* Malloch.

Macrozanthomyia MALLOCH, 1930, Ann. Mag. Nat. Hist., V, p. 43, as a subgenus of *Dichaetomyia* Malloch.

The type of *Panaga* is *limbipennis* Curran, of *Macrozanthomyia*, *distanti* Malloch.

Panaga was separated from typical *Dichaetomyia* on account of the presence of setulae on the suprasquamal declivity and the presence of four postsutural dorsocentrals. *Macrozanthomyia* was proposed for species having the infra-alar bullae haired, and the genotype lacks the setae on the suprasquamal declivity and has but three postsutural dorsocentrals. Both genotypes agree in having the infra-alar bullae haired, the other characters being variable, and I believe that the group is entitled to generic rank.

TABLE OF SPECIES

- 1.—Three postsutural dorsoventrals.....3.
Four postsutural dorsocentrals2.
- 2.—Wings unicolorous.....*albivitta* Stein.
Wings with the costal border broadly brown on the apical half.
limbipennis Curran.
- 3.—Sides of the scutellum bare below the marginal bristles.....4.
Sides of scutellum haired to the lower border or nearly so.....7
- 4.—Anterior tibiae with a posterior bristle near the middle.....5.
Anterior tibiae without median bristles.....6.
- 5.—Mesonotum with a broad, dark median vitta.....*serena* Stein.
Mesonotum rusty reddish, almost unicolorous*distanti* Malloch.
- 6.—Abdomen and scutellum wholly yellowish.....*immaculiventris* Malloch.
Abdomen black or brown, the base and broad segmental apices yellow; scutellum with the disc black or brown.....*maculiventris* Malloch.
- 7.—Anterior tibiae with a posterior bristle near the middle.....8.
Anterior tibiae with only the apical bristles.....10.
- 8.—Several black setulae below the inner end of the squamae.....*obscuritarsis* Malloch.
No infrasquamal setulae.....9.
- 9.—Posterior femora with several long, posteroventral bristles on the basal half.
fasciventris Malloch.
Posterior femora with at most one posteroventral bristle on the basal half.
celosia Malloch.
- 10.—Suprasquamal declivities with black setulae.....11.
Suprasquamal declivities bare.....12.
- 11.—Mesonotum with a conspicuous median white spot in front; large species.
ovata Stein.
Mesonotum without white spot in front.....*rutila* Stein.
- 12.—Tarsi wholly black or brown.....*pallens* Curran.
Tarsi wholly reddish.....*graueri*, new species.

***Panaga albivitta* Stein**

Spilogaster albivitta STEIN, 1906, Berl. Ent. Zeitschr., LI, p. 41 (Togo).

Dichaetomyia (*Macrozanthomyia*) *albivitta* MALLOCH, 1930, Ann. Mag. Nat. Hist., V, p. 475.

Malloch records the species from Sierra Leone, Kenya and Tanganyika.

Very similar to *limbipennis* Curran but distinguished by having unicolorous wings.

***Panaga limbipennis* Curran**

Dichaetomyia (*Panaga*) *limbipennis* CURRAN, 1928, Bull. Amer. Mus. Nat. Hist., LVII, p. 353.

The type, female, was from Panga, Congo.

***Panaga serena* Stein**

Spilogaster serena STEIN, 1906, Berl. Ent. Zeitschr., LI, p. 53. (Nyasaland).

Spilogaster unilineata STEIN, 1906, Berl. Ent. Zeitschr., LI, p. 53 (Pungo Andango).

Dichaetomyia (*Macrozanthomyia*) *unilineata* MALLOCH, 1930, Ann. Mag. Nat. Hist., V, p. 476.

Malloch records the species from Natal, Nyasaland, Kenya and Uganda.

In his catalogue of Muscidae Stein placed *unilineata* as a synonym of *serena*.

***Panaga distanti* Malloch**

Dichaetomyia (*Macrozanthomyia*) *distanti* MALLOCH, 1930, Ann. Mag. Nat. Hist., V, p. 475.

Two females, East London, Cape Province, May 9, 1923, and January 27, 1925; male and three females, Pretoria, Transvaal, February 22, 27, 1915, April 29, 1915, and May 18, 1919 (H. K. Munro); three females, Pretoria, June 6, 1915, on window pane (collector ?); two males, Balla Balla, Southern Rhodesia, May, 1931; female, Salisbury, Southern Rhodesia, November, 1932 (A. Cuthbertson).

***Panaga immaculiventris* Malloch**

Dichaetomyia (*Macrozanthomyia*) *immaculiventris* MALLOCH, 1930, Ann. Mag. Nat. Hist., V, p. 477.

Described from Lourenco Marquis and doubtfully from Nyasaland. Male, Gurungwe, Southern Rhodesia, July, 1933 (A. Cuthbertson); male, "Waboniland."

***Panaga maculiventris* Malloch**

Dichaetomyia (*Macrozanthomyia*) *maculiventris* MALLOCH, 1930, Ann. Mag. Nat. Hist., V, p. 478.

Two females from Pretoria, Transvaal, July 22, 1913, and May 2, 1914 (H. K. Munro).

The color of the mesonotum and scutellum varies from ferruginous to reddish yellow.

***Panaga obscuritarsis* Malloch**

Dichaetomyia (*Macrozanthomyia*) *obscuritarsis* MALLOCH, 1930, Ann. Mag. Nat. Hist., V, p. 476.

The type, a female, came from Nigeria. A second damaged specimen from Uganda was doubtfully referred to the species.

***Panaga fasciventris* Malloch**

Dichaetomyia (*Macrozanthomyia*) *fasciventris* MALLOCH 1930, Ann. Mag. Nat. Hist., V, p. 476.

This species was described from three specimens from southern Nigeria.

***Panaga celosia* Malloch**

Dichaetomyia (*Macrozanthomyia*) *celosia* MALLOCH, 1930, Ann. Mag. Nat. Hist., V, p. 477.

Originally described from Southern Rhodesia, Nigeria and Uganda. I have before me a male and female from northwest Tanganyika and a female from Forest Moera, 1910 (Grauer).

Malloch describes the species as having no bristles on the postero-ventral surface of the posterior femora, but in the key states that there is at most one; all of my specimens possess one near the base and another before the middle.

***Panaga ovata* Stein**

Mydaea ovata STEIN, 1918, Ann. Mus. Nat. Hung., XVI, p. 192.

Dichaetomyia (*Macrozanthomyia*) *ovata* MALLOCH, 1930, Ann. Mag. Nat. Hist., V, p. 478.

Female, Lenga Town, Liberia, August 5, 1926 (J. Bequaert).

***Panaga rutila* Stein**

Mydaea rutila STEIN, 1918, Ann. Mus. Nat. Hung., XVI, p. 192.

Male, Ngoma, Congo, February 2, 1927; female, Bakratown, Liberia, October, 1926 (J. Bequaert).

***Panaga graueri*, new species**

Rusty reddish-yellow, with black markings; suprasquamal declivities bare; anterior tibiae without posterior bristle; sides of scutellum haired. Length about 8 mm.

FEMALE.—Head black, the facial ridges reddish; cinereous pollinose, the frontal vitta bare; eight pairs of frontals, the anterior pair very strong, the others weak, the upper two pairs reclinate; outer verticals strong. Proboscis brown, the palpi reddish brown. Antennae yellow, the third segment mostly brown; arista yellowish on the basal half, with long, black rays.

Mesonotum rusty reddish, with four broad, darker vittae, the spaces between them thinly white pollinose from posterior view and the vittae themselves appearing whitish from anterior view. Hair black; dorsocentrals 2-3; prescutellar acrosticals strong. Scutellum with two pairs of strong bristles and four weak marginals, the sides haired. Sternopleurals 1-2. A black spot on the front of the pteropleura.

Legs entirely reddish yellow; anterior tibiae without median bristle; posterior femora wholly without bristles on the basal three-fourths of the posteroventral surface and with only two on the basal half of the anteroventral surface, the bristles on the apical half fine.

Wings luteous; costal bristle short. Squamae luteous, darker apically. Halteres reddish, the base of the knob darkened.

Abdomen rusty reddish, the apices of the first to third segments narrowly brown. Fourth segment with a medianly interrupted row of discs. First sternite with short hair, the bristles fine.

TYPE.—Female, northwest Tanganyika, 1910 (Grauer), in Vienna Natural History Museum.

***Panaga pallens* Curran**

Dichaetomyia pallens CURRAN, 1928, Bull. Amer. Mus. Nat. Hist., LVII, p. 352.

The type came from Stanleyville, Congo; female, northwest Tanganyika, 1910, and male, Ukaika, December, 1910 (Grauer).

SYNONYMY

Panaga unilineata Stein = *serena* Stein.

***AETHIOPOMYIA* Malloch**

MALLOCH, 1921, Ann. Mag. Nat. Hist., VII, p. 426.

The only species included in this genus is *gigas* Stein. A second species is before me from Cameroon.

TABLE OF SPECIES

Geminate mesonotal vitta black; bristles on the sternites long and very robust.

gigas Stein.

Geminate vittae reddish; bristles on sternites only moderately strong. . . *steini*, n. sp.

Aethiopomyia gigas Stein

Spilogaster gigas STEIN, 1906, Berl. Ent. Zeitschr., LI, p. 37 (Cameroon).

CURRAN, 1928, Bull. Amer. Mus. Nat. Hist., LVII, p. 354 (Congo).

MALLOCH, 1921, Ann. Mag. Nat. Hist., VII, p. 425.

One male, East London, Cape Province, April 26, 1922 (H. K. Munro).

Aethiopomyia steini, new species

STEIN, 1906, Berl. Ent. Zeitschr., LI, p. 39. (Note under *Spilogaster* (!) *arguta* Karsch.)

Very similar to *gigas* Stein but differing in having the mesonotal vittae reddish and much finer bristles on the sternites. It differs from *Alluaudinella arguta* Karsch in having the third and fourth abdominal segments wholly black in addition to generic characters. Length, 9.5 to 11.5 mm.

MALE.—Head black, the face and lower third of the front reddish in ground color; pollen silvery white. Eyes separated by about twice the width of the ocellar triangle; frontal vitta brownish, very narrow except below; six pairs of strong frontals, the upper pair reclinate, and a few weak ones; ocellars short, but there is a pair of slightly reclinate, strong bristles situated behind the ocellar triangle; verticals weak. Cheeks very narrow, with black bristly hair and some fine brownish-yellow hairs. Palpi reddish brown. Antennae yellow, the long, plumose arista mostly brown. Eyes with enlarged facets anteriorly.

Thorax rusty reddish, darker above; mesonotum with an incomplete median vitta and the lateral margins whitish pollinose, posteriorly with reddish-brown pollen, the two broad, shining ferruginous vittae more or less divided by a slender yellowish pollinose line in front of the suture. Scutellum rusty reddish, pale brownish red pollinose. Dorsocentrals 3-4; one posthumeral; two intra-alars; prealar absent; three pairs of marginal scutellars and no discals, the hair on the sides of the scutellum extending to the lower margin and part of the ventral fringe tawny; sternopleurals 1-2; propleura, pteropleura and prosternum haired. Hair black, yellow on the propleura, prosternum and part of the sternopleura.

Legs reddish, posterior and middle tibiae more or less brown, the tarsi black. Middle femora with a row of anteroventral and posteroventral bristles on the basal half, the posterior pair with rows on their whole length. Anterior tibiae without posterior bristles, the middle ones with four or five short ones; posterior tibiae with two anterodorsal and two or three anteroventral bristles on the median half.

Wings with luteous tinge; fourth vein moderately curved forward apically; stem of second and third veins setulose above and below. Squamae yellowish, the lower lobe convex inwardly but not produced sufficiently to extend under the scutellum. Halteres reddish yellow.

Basal two abdominal segments rusty reddish, the third and fourth black, the second to fourth each with a narrow white pollinose basal fascia; second segment with a narrow apical fascia and a broader median vitta black, the first with the apex narrowly blackish; third segment sometimes with the base narrowly reddish; third and fourth segments appearing pale brownish pollinose in some lights. Third segment with a row of eight or ten strong, erect marginals, the fourth with a row of

marginals and discals. Venter mostly reddish, the sternites with long, fine bristles. Hair black except on the basal sternite.

FEMALE.—Frontal vitta reddish, brown above; no orbitals; mesonotum with very poorly defined dark vittae, almost unicolorous.

TYPES.—Holotype, male, and three male paratypes, Eden, Cameroon (J. A. Reis). Allotype, female, Sierra Leone (C. J. Wainwright collection).

Stein had this species from Cameroon and mentioned it in connection with *Spilogaster arguta* Karsch.

ALLAUADINELLA Giglio-Tos

GIGLIO-TOS, 1895, Ann. Soc. Ent. France, LXIV, p. 363.

MALLOCH, 1921, Ann. Mag. Nat. Hist., VII, p. 426.

MALLOCH, 1925, Ann. Mag. Nat. Hist., XVI, p. 364.

A genus known only from Africa and to which seven species are assigned. The following table separates the forms known to me.

TABLE OF SPECIES

- | | |
|--|----------------------------|
| 1.—Humeri yellow-haired laterally..... | 2. |
| Humeri black-haired on the sides..... | <i>arguta</i> Karsch. |
| 2.—The two shining vittae of the thorax black in front of the suture..... | 3. |
| The vittae wholly rusty reddish..... | 4. |
| 3.—Length at least 11 mm..... | <i>evanescens</i> Stein. |
| Length less than 8 mm. (Mauritius)..... | <i>bivittata</i> Macquart. |
| 4.—Mesonotum, from anterior or dorsal view, with a black median vitta. | |
| | <i>centralis</i> Malloch. |
| Mesonotum without black vittae..... | 5. |
| 5.—Posterior tibiae with posterodorsal bristle near the middle. <i>fulvovittata</i> Malloch. | |
| Posterior tibiae without posterodorsal bristles..... | <i>lativentris</i> Stein. |

Allauadinella *arguta* Karsch

Spilogaster arguta KARSCH, 1879, Zeitschr. Nat., LII, p. 381.

MALLOCH, 1925, Ann. Mag. Nat. Hist., XVI, p. 365.

Six females from Forest Beni and Forest Moera, 1910 (Grauer).

The species may be recognized by the presence of coarse black hairs on the humeri below the humeral bristles. In the other species examined the hair is all yellow below the bristles. The black mesonotal vittae may be entirely absent and the black area on the fourth abdominal segment is variable in size.

Allauadinella ? *bivittata* Macquart

Aricia bivittata MACQUART, 1843, 'Dipt. Exot.', II, part 3, p. 162 (f.).

?MALLOCH, 1925, Ann. Mag. Nat. Hist., XVI, p. 365.

Described from Mauritius and recorded from continental Africa.

A. evanescens Stein is apparently a distinct species, being larger, and I believe that Malloch's specimen recorded from southern Nigeria belongs to *evanescens*. The length of *bivittata* is given as $3\frac{1}{2}$ lines, or less than 8 mm.

***Allauadinella evanescens* Stein**

Spilogaster evanescens STEIN, 1906, Berl. Ent. Zeitschr., LI, p. 39.

?*Allauadinella bivittata* MALLOCH, 1925, Ann. Mag. Nat. Hist., XVI, p. 365.

Two females from Liberia: Bakratown, September 30, 1926, and Banga, October, 1926 (J. Bequaert).

One specimen has a small, oval, black spot on the bases of the second and third abdominal segments while the other has these segments wholly rusty reddish.

***Allauadinella ? flaviceps* Karsch**

Spilogaster flaviceps KARSCH, 1887, Berl. Ent. Zeitschr., XXXI, p. 379.

I do not know this species, which is the type of the genus.

***Allauadinella fulvovittata* Malloch**

MALLOCH, 1921, Ann. Mag. Nat. Hist., VII, p. 427.

MALLOCH, 1925, Ann. Mag. Nat. Hist. XVI, p. 365.

Female, Paiaata, Liberia, October, 1926 (J. Bequaert).

There is nothing in the description of this species by which it may be distinguished from *lativentris* Stein except the smaller size, and this may not be a reliable criterion. If I have correctly identified the species it may be distinguished by the presence of a posterodorsal bristle on the posterior tibiae.

***Allauadinella lativentris* Stein**

Spilogaster lativentris STEIN, 1906, Berl. Ent. Zeitschr., LI, p. 40.

Female, Banga, Liberia, October, 1926 (J. Bequaert); three females from Forest Beni and Forest Moera, 1910 (Grauer).

The length varies from 10 to 12 mm. and the apex of the abdomen may or may not be brownish.

***Allauadinella centralis* Malloch**

MALLOCH, 1925, Ann. Mag. Nat. Hist., XVI, p. 365 (Uganda).

Allauadinella congensis CURRAN, 1928, Bull. Amer. Mus. Nat. Hist., LVII, p. 353 (Congo).

Male, Durban, Natal, (collector ?); male, Ngomo, Congo, February 2, 1927 (J. Bequaert); female, "Waboniland."

This species differs from the other males that I have seen in having the fifth sternite entire and bearing a pair of very small apical tubercles in the middle.

GRAUERIA, new genus

Arista plumose; front with one pair of proclinate orbitals and a pair of cruciate interfrontals. Acrosticals and dorsocentrals 2-3; sternopleurals 1-2; three pairs of marginal scutellars and a pair of discals, the scutellum haired to the lower edge; propleura bare in the middle; pteropleura with hair; posterior spiracle large, elongate. Front tibiae with three apical bristles, two of them situated on the upper surface. First and third veins setulose above, the third with basal setulae on the under surface; third vein curving back at the apex, the fourth not curving forward. Squamae small, not expanding inwardly toward the scutellum. Abdomen short oval, almost as wide as long.

GENOTYPE:—*G. ethelia*, new species.

The male is unknown but the genus is evidently related to *Neaveia* Malloch. It may be at once distinguished by the bristled first and third veins.

Graueria ethelia, new species

Rusty reddish-yellow, the front and mesonotum blackish in ground color; front tibiae with only apical bristles; scutellum haired to the lower edge. Length, about 7 mm.

FEMALE.—Front black, brownish on about the anterior half, the parafrontals with whitish pollen; one pair of orbital bristles; seven pairs of frontals, the upper pair strong and reclinate; ocellars long; postocellars very short; verticals and outer verticals long. Occiput blackish, cinereous pollinose; hair black, reddish below. Checks brown, about one-fifth as wide as the eye-height, the hair sparse and black. Middle of face reddish in ground color, the pollen cinereous. Proboscis reddish brown; palpi reddish yellow. Antennae reddish, the third segment more yellowish; arista brown.

Thorax rusty reddish-yellow, with brownish-yellow pollen; mesonotum blackish in ground color except laterally; from posterior view with three broad cinereous-yellow vittae extending from the front margin to well behind the middle, these vittae appearing brown from anterior view. Acrosticals 2-3; dorsocentrals 2-3; three pairs of marginal scutellars and a weak pair of discals, the scutellum haired to the lower edge; sternopleurals 1-2.

Legs reddish yellow, with black hair, the tarsi brown from the apex of the first segment; anterior tibiae with only the apical bristles.

Wings cinereous hyaline; first vein bristled beyond the humeral cross-vein, the third with bristles to well beyond the anterior cross-vein on the upper side and with several basal bristles below; fourth vein not or scarcely curved forward apically. Squamae small, reddish yellow; halteres yellow.

Abdomen rusty reddish-yellow, with black hair, the extreme apices of the second and third segments brown; no strong bristles, but there are weak marginals on the second and third segments and a row of very weak discals on the sides of the fourth segment beyond the middle.

HOLOTYPE.—Female, northwest Tanganyika, 1910 (Grauer), in Vienna Natural History Museum.

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BAIRDOPPILATA, A NEW GENUS OF OSTRACODA, WITH TWO NEW SPECIES

By H. N. CORYELL,¹ C. H. SAMPLE,² AND P. H. JENNINGS¹

INTRODUCTION

The genus *Bairdia* McCoy, 1844, from the Carboniferous of Ireland, has been one of the most commonly used genera, whether in discussions, citations, faunal lists, or as the recipient of a varied assortment of species. Up to the present time more than 380 specimens have been described as different species of *Bairdia*, and many of them are by most students of these forms still considered as properly classified. Scarcely a large fauna of Ostracoda has been described from the late Paleozoic, Mesozoic, Tertiary, or later deposits without finding a few species of *Bairdia* in the assemblage. It should be unusual to expect an arthropod to maintain a constancy of developmental trends through so long a period of time, without some fundamental additions to its methods of living, or structural changes supported by biological habits. Whenever the anatomy of the soft tissues among the recent Crustacea shows variations, these differences reflect their presence in the structures of the hard parts, and it seems possible that the reverse method of interpretation would be possible among the fossil forms where only the skeletons are left.

Those features of the skeleton that should most readily show evidence of other anatomic change in the individual of the arthropod group should be on the inner surface of the exoskeleton, and would very probably be connected with those tissues that employ the hard parts in performing their own services to the individual. Among those characters are the muscle scars, vascular furrows, and articulation surfaces.

The dentition or area of articulation of the Ostracoda has been considered of primary importance. Several genera have been distinguished from one another on this basis. It is thought that a difference in arrangement of the articulating grooves, sockets, bars, protuberances, or area of dorsal contact, whether complex or simple, ranks quite high in reflecting other changes among the body tissues. Among specimens

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²Houston Oil Company of Texas, Houston, Texas.

which have been buried in the rocks for a long time, these features are given this broad style of interpretation.

There is some difficulty in preparing the older specimens for a study of the contact relationships, and not every one possesses the possible proper conditions. Because of the extra labor, and the destruction of many otherwise splendidly preserved specimens in making them ready for observations of the contact, the study of the interior of the ostracods has been done mostly by those paleontologists working with single valves, and especially with those specimens from the late Mesozoic or younger strata.

In addition to the genera already described and separated from one another on articulating structure, we wish to call attention to another one that has many external characters in common with the genus *Bairdia*, and yet is different from it in the hingement features. It is even possible that many of the species that belong to the new group have been referred to *Bairdia*.

DESCRIPTION OF THE GENUS AND SPECIES

BAIRDIIDAE Sars, 1887

BAIRDOPFILATA, new genus

GENOTYPE.—*Bairdopfilata martyni*, new species

Carapace small, smooth, or finely punctate; bairdiaoid in lateral view; left valve is larger and overlaps the right on all margins, but more on the dorsal and mid-ventral than elsewhere. The ventral margin of each valve may or may not be frilled. The hingement of the left valve consists of a groove and an adjacent ridge on the dorsal side, along the straight contact, posterior to the highest angulation of the dorsal margin; along the dorsal margin to the anterior angulation, and along the posterior dorsal slope to the posterior acute angulation, the groove structure disappears before the middle of each slope is reached; just dorsal of the angulations on each end of the valve, and within the overlap margin, are a short series of transverse teeth and sockets, supported upon the internal marginal platform. The hingement of the right valve consists of a bar-like ridge with a groove along its dorsal side, which fits into the articulating structure of the left valve, and also a series of teeth set upon the margin of the valve just above the terminal angulations to mesh with those of the left valve.

RANGE.—Cretaceous and Tertiary.

This genus is easily distinguished from *Bairdia* by the articulating pattern that includes the transverse teeth.

Bairdoppilata martyni, new species

Carapace is short, the height greater than twice the length; dorsal margin is highly arched and angulated at the location of greatest height. The surface is smooth, strongly convex; greatest height slightly anterior of the middle; greatest thickness nearly central. The hinge contact is straight, consisting of a groove and bar type, characteristic of the genus; this straight contact surface slopes from the highest portion of the dorsal

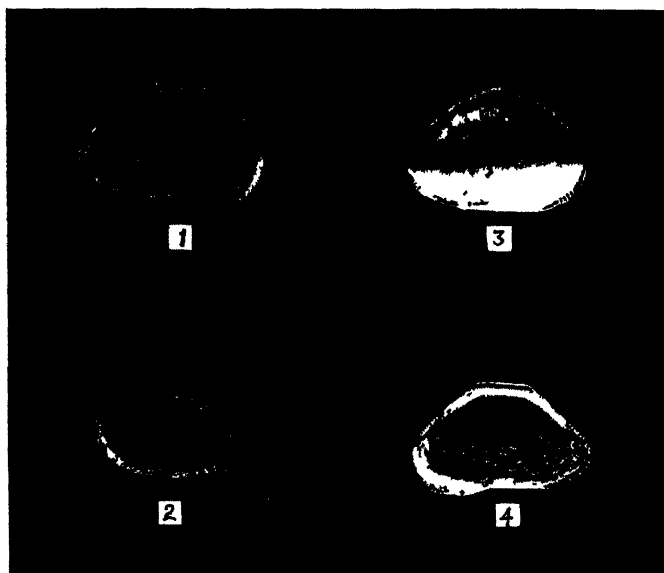


Fig. 1. *Bairdoppilata martyni*, n. sp. Cotype. Interior of left valve. $\times 25$. Amer. Mus. Cat. No. 24251.

Fig. 2. *Bairdoppilata martyni*, n. sp. Cotype. Interior of right valve. $\times 20$. Amer. Mus. Cat. No. 24252.

Fig. 3. *Bairdoppilata viticula*, n. sp. Cotype. Right valve. $\times 20$. Amer. Mus. Cat. No. 24253.

Fig. 4. *Bairdoppilata viticula*, n. sp. Cotype. Interior of right valve. $\times 20$. Amer. Mus. Cat. No. 24254.

margin, downward to the median angulation in the posterior slope. The internal marginal platform rises gradually from the middle of the lower half of the dorsal posterior slope to its widest portion around the posterior acute angulation, and extends inward as a shelf. This shelf becomes very narrow in the region of the greatest ventral overlap of the left valve over the right, and it appears as if the polished surface of the

internal platform becomes completely adnate to the interior of the valve here. Farther towards the front of the valve the inner margin of the platform rises from the inner surface of the valve and becomes a narrow shelf or septum, while most of the width of the internal platform remains in contact with the inner surface. The areas of dentition in the left valve lie just above the terminal angulations of the valve, and extend diagonally across the width of the internal platform surface, with the outer end nearest the angulation of the shell, and continue upward and inward near to the inner border of the platform (line of concrescence), forming a broad arc, convex inward, and bearing six or seven transverse teeth and sockets. Near the outer margin of the inner platform is a sinuous groove that receives the ventral edge of the right valve, the sinuosity curving inward as it passes around the extended overlap of the left valve, and conforms to the depression in the right valve in which the lip-like overlap of the left fits. The hingement of the right valve consists of bar and groove to mesh with those in the left valve on the posterior slope from the highest portion of the dorsal margin to the angulation. The remaining part of the margin of the right valve, on the ends, is narrowed to fit with the border of the left; just above the terminal angulations, teeth and sockets are present on the edge, to mesh with those in the left. The construction of the inner platform in the right valve is quite like that in the left.

LENGTH.—1.03 mm. HEIGHT.—0.68 mm.

OCCURRENCE.—Lower Miocene: Marl just below Chione Limestone in Lower Chickasawhay formation, Wayne County, Mississippi. Collected by Mr. C. H. Sample and named for P. F. Martyn, Geologist of the Houston Oil Company, Houston, Texas.

TYPES.—American Museum of Natural History, New York, N. Y. Catalogue numbers 24251, 24252.

***Bairdoppilata viticula*, new species**

Carapace short, bairdiaoid in lateral view; the dorsal margin highly arched and angulated at the crest; the dorsal contact is angulated at the crest and again near the mid-posterior slope. The posterior acuteness lies below the line of mid-height; and the anterior angulation projects forward at the line of mid-height. The dorsal articulating ridge and groove hingement contact is shorter than in *B. martyni* and dips posteriorly less steeply. The construction of the internal marginal platform is less adnate along the edges and ventral margin than in *B. martyni*. The surface is strongly convex, with the greatest thickness of the specimen near the center, and is finely punctate, with the puncta scarcely

showing on the crest of the convexity, conspicuous and very closely spaced on the anterior half of the valve, and somewhat more widely spaced on the posterior slope; the closely spaced arrangement is also more common near the ventral margin.

Very near to, and paralleling the edge of the valve is located a delicate, narrow, radially grooved, broadly scalloped frill. It is attached to the exposed margin of the closed valves along the ventral anterior and posterior borders, and extends upward along the terminal margins to the acuminations. It is more conspicuous on the right valve.

LENGTH.—1.13 mm. HEIGHT.—0.75 mm.

OCCURRENCE.—Upper Cretaceous: *Exogyra cancellata* zone of the Mount Laurel Sand. Collected by Mr. Philip H. Jennings on Crosswicks Creek, .6 mile north of New Egypt, New Jersey, on Mr. Nutt's farm.

TYPES.—American Museum of Natural History, New York, N. Y. Catalogue numbers 24253, 24254.

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A PHOTOGRAPH AND DESCRIPTION OF *MASTURUS LANCEOLATUS* TAKEN AT TAHITI, MAY, 1930

THE SIXTEENTH ADULT SPECIMEN ON RECORD

BY E. W. GUDGER

Through the kindness of Mr. Charles Nordhoff of Papeete, Tahiti, the American Museum is in possession of a photograph of this rare sunfish, the best of three on record, and of the data concerning the fish and its capture. This photograph is such a treasure that it should be published without further delay. But since the pointed-tailed sunfish is so little known (this one being the sixteenth recorded specimen), a brief account of its history and distribution will be added.

The data communicated by Mr. Nordhoff were collected by Mr. Georges W. H. Spitz, and the photograph was taken by Mr. William Crake, both of Papeete. The ichthyologists of the world are indebted to these three gentlemen for their efforts to get the data as to the occurrence of this very rare fish, and its photograph, and to pass them on to be preserved on the published page.

CAPTURE OF *Masturus* AT TAHITI

The history of this interesting specimen is as follows. The fish was caught in Matavai Bay, Haapape, Tahiti, on May 21, 1930. In front of Mahina Plantation, owned by Mr. Charles C. Curtis, a member of the American Museum, is a net fishery in charge of Temeehu, an expert native fisherman. On the day noted, the fish had evidently come in with the easterly trade wind through a break in the reef, and had been left by the receding tide in a shallow wash on the sandy beach, in water of too little depth for it to swim. Here it was caught by Temeehu. When the attention of Mr. Spitz was called to this fish, he recognized it as a rarity, purchased it, had it photographed, and presented it to the Société des Études Océaniques, in whose museum at Tahiti its skin now is. It was identified by Mr. Nordhoff with the aid of H. W. Fowler's 'Fishes of Oceania.'

The measurements of this half-grown specimen are as follows: length, 37.5 in., of which the projecting stumpy tail was 7 in.; depth

21 in., with dorsal and anal fins each measuring about 12 in., giving a total depth of about 40 to 45 in.; thickness about 6 in. The weight was 30 kilos or about 66 lbs. When caught, two sucking fishes (each about

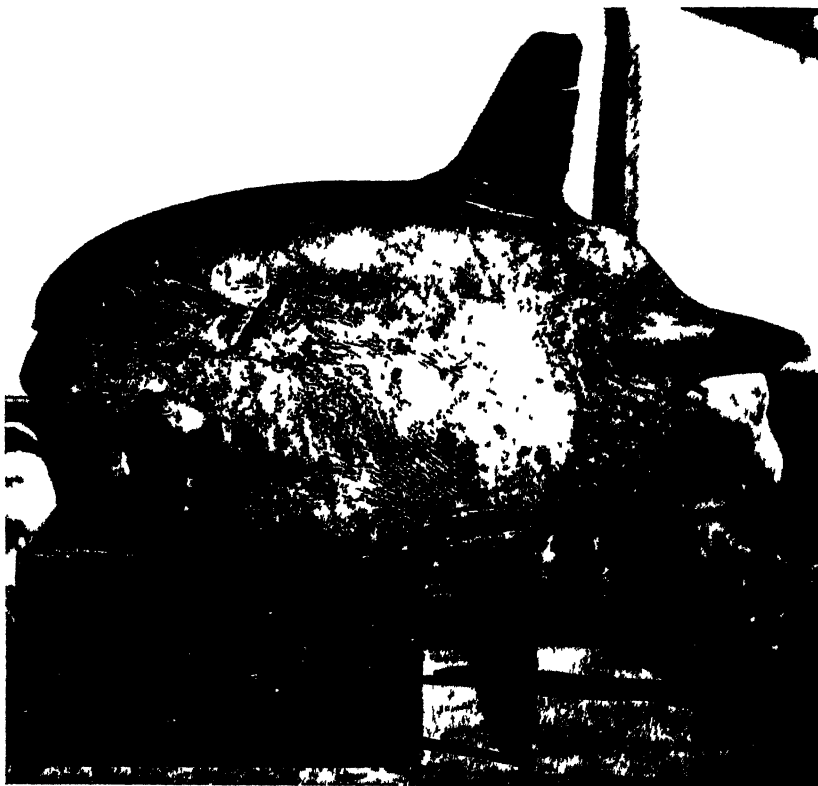


Fig. 1. The pointed-tailed ocean sunfish, *Masturus lanceolatus*, taken at Papeete, Tahiti, May 21, 1930.

Photograph by courtesy of Mr. Charles Nordhoff.

a foot long) were attached on opposite sides of the head, just below each eye. They held on, as they frequently do, until the fish was brought ashore.

Figure 1, made from Mr. Crake's photograph, is by long odds the best representation of this fish ever made. This statement comes after an examination of all published figures. Note the general shape of the body, the relative positions of mouth, eye, small gill aperture, and pectoral

fin, and the wrinklins over the abdominal region. The greatest interest, however, is in the tail, and particularly in the caudal stump. This, which looks to be in line with the vertebral column, is above the median line of the caudal region. It appears as if there were a median rod with the tissues sinking away above and below and being molded into the dorsal and ventral ridges. The point looks as though it had been mutilated. No other figure, save only that made from the Prince of Monaco's photograph, shows such a markedly elongate stump of the caudal fin.

Particular attention must also be called to the spots on the caudal fin and stump. They are to be seen on the base of the dorsal fin and more plainly on that of the anal. Some are also scattered over the body. One wonders if there should not be more. Probably this photograph was not made until some hours after the capture of the fish and until the heat and light of a tropical sun had caused much fading of the colors.

Mr. Nordhoff writes that the pointed-tailed sunfish is so rare at Tahiti that he was able to find only one old native who claimed to know it and who called it "Metua Aahi" or "Parent of the Albacore." The scientific name is interesting—*Masturus*=*maest*, Anglo-Saxon mast or spar+*ura* or *oura*, tail; and *lanceolatus*=a little lance. The names are redundant, emphasizing the fact that the hard stump of a tail projects beyond the general contour of the hinder tail region.

DISCOVERY OF *Masturus* AT MAURITIUS

The pointed-tailed sunfish was discovered at the island of Mauritius and described from two specimens. The first was harpooned in the bay of Grande-Rivière, where it was stranded in water about 3 ft. deep, on May 24, 1835 or 1836 (both dates are given). It was a half-grown fish about 52.5 in. long over all and about 25.5 in. deep. It weighed 117.7 lbs. The second, a full-grown fish, was taken in the roadstead of Port Louis, where it had come aground, on February 7, 1839. This large fish was about 90 in. in total length, and about 43.5 in. in depth. It weighed 742.5 lbs.

Liénard read his paper describing these fishes before the Société d'Histoire Naturelle de l'Ile Maurice on March 7, 1839. A preliminary abstract, 'Description d'une nouvelle espèce du genre Mole (*Orthogoriscus*, Schn.) découverte à l'Ile Maurice,' was published in *Revue Zoologique*, Paris, 1840 (pp. 291-292). The full paper bearing the same title with the addition "et nommée *Orthogoriscus lanceolatus*" appeared with a drawing the following year in *Magasin de Zoologie*, Paris, 1841,

series 2, volume 3, 8 pages, plate. Liénard's figure, the first published, is here shown (Fig. 2) for contrast with the latest published (Fig. 1).

Incidentally it may be remarked that Liénard's smaller specimen had fourteen sucking fish attached to it but only one could be captured. An hour after the bringing ashore of the second fish, two living sucking fishes

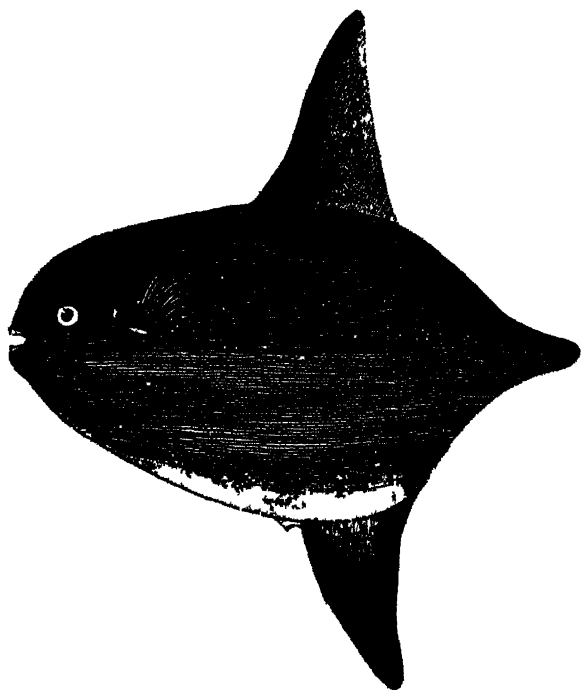


Fig. 2. The first figure of *Masturus lanceolatus* (from Mauritius).
After Liénard, 1841.

(size not stated) came out of its gill openings. These two phenomena are not unusual. Large echeneids are commonly found sticking to the sunfish's skin (as found on the Tahitian fish) and small ones are almost always found in the gill cavities.

RELATIONSHIPS OF *Masturus*

It is in order briefly to note the place of this interesting fish in the system. Details will be left for another article.

The ocean sunfishes, comprising the family Molidae, belong to three genera. The oldest genus is *Mola* or *Orthogoriscus*, the short or round-bodied and round-tailed, or millstone-shaped form (*L. mola* = a millstone). This, the commonest form, especially in western European waters, was first figured and described separately in 1554 by two of the fathers of ichthyology, Rondelet and Salviani. *Mola*, as a generic name, was established by Cuvier in 1798, and *Orthogoriscus* by Swainson in 1839.

The second genus, *Ranzania*, the oblong or truncate-tailed sunfish, was established by Nardo in 1839. It was named after another Italian naturalist, Ranzani, who published in 1839 a memoir on the Molidae. It is interesting to note that the species in Hawaiian waters is *R. makua*, and that the specific name means king of the mackerels. This recalls the native Tahitian name, *metua aahi*, parent of the albacore.

The discovery of the third genus, *Masturus*, by Liénard at Mauritius, has been noted. He called his fish *Orthogoriscus lanceolatus* in 1840. Klunzinger collected a specimen at Kosseir on the Red Sea about 1865 but did not know what a treasure he had when he described his fishes in 1871. Bleeker in 1873 figured and described a specimen from Amboina as *Orthogoriscus oxyropterus*. The genus, *Masturus*, was established by Gill, in 1885. There is but the one species, *lanceolatus*.

The Molidae, together with the families Diodontidae, Tetraodontidae, and others, belong to the suborder Gymnodontes (naked-toothed fishes), and to the order Plectognathi (fused-jawed fishes) of the great group, Teleostei or bony fishes.

HISTORY AND DISTRIBUTION OF *Masturus*

In view of the capture of *Masturus lanceolatus* at Tahiti (the sixteenth recorded specimen), a brief statement of the very wide distribution of this ichthyological rarity will be of interest. Bibliographic and other details will be omitted.

Little is known about *Masturus*. Thus Hubbs in 1931 was able to enumerate but 7 recorded adult specimens (counting Liénard's 2); and Smedley in 1932 listed 7 including 2 not known to Hubbs, but omitting 2 others in Hubbs' list. The total known to the two men was then but 11. However, in this paper I am able to record 16 adult specimens including that under consideration. From this it can be seen how extremely rare is this large marine fish. The list follows in chronological order.

No.	Date	Reporter	Locality
2	1840, 1841.	The type figured and it and the paratype described by Liénard from Mauritius.	
1	1871.	Listed by Klunzinger from the Red Sea and deposited in the Berlin Museum. Identified by Collett in 1896 and by Steenstrup and Lütken in 1898.	
1	1873.	Figured and described by Bleeker from Amboina.	
1	1889.	Figured and described by Albert I. of Monaco in 1889, and by Collett in 1896, from the Atlantic Ocean 350 miles west of the Azores.	
1	1918.	Figured by Townsend from east coast of Florida.	
1	1922.	Figured and described from Hawaii by Jordan and Jordan and by Fowler in 1928.	
5	1927.	Described and one figured by Barnard from Table Bay, South Africa.	
1	1931.	Described by Hubbs and Giovanolli from east coast of Florida.	
1	1931.	Noted by Hubbs in a Japanese museum.	
1	1932.	Figured and described by Smedley from near Singapore.	
1	1935.	Figured and described by Gudger from Tahiti.	
16	1840-1935. Total recorded adult pointed-tailed ocean sunfishes.		

In addition to the 16 adults listed in the table, I have been able to locate 16 young from about 20 to 60 mm. in the North Atlantic Ocean. In addition to these, the late Johannes Schmidt identified considerable numbers of larval and postlarval young from the North Atlantic, particularly from the Sargasso Sea. There can be no doubt that *Masturus* breeds in the North Atlantic. The adults from the three warm oceans and their dependencies are listed in the accompanying table.

DISTRIBUTION OF *Masturus lanceolatus* BY OCEANS

	Indian Ocean
3	2 from Mauritius; +1 from Red Sea
	Pacific Ocean
5	1, Singapore; +1, Amboina; +1, Japan; +1, Tahiti; +1, Honolulu; (+2 young)
	Atlantic Ocean
8	5, Table Bay; +2, Florida; +1, Azores; +(14 young)
16	adults +16 young +an indefinite number of post-larval forms referred to but not definitely enumerated by Johannes Schmidt

In another paper, I purpose to trace the history of *Masturus lanceolatus* in the Indian, Pacific, and the Atlantic Oceans, to give distributional maps and to reproduce all the obtainable figures of this fish, perhaps the rarest of the larger forms.

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SOME SPONGES OF LOWER CALIFORNIA (MEXICO)

BY M. W. DE LAUBENFELS

The sponges of the west coast of Mexico have been very little studied. Wilson (1904, *Memoirs of the Museum of Comparative Zoology of Harvard*, XXX, No. 1) described collections made by the Steamer 'Albatross' in that general region, but chiefly rather far from land and in very deep water. For comparison with species of nearby coasts, only shallow water species have zoögeographical interest, because the sponges of deep water are highly modified for their environment and appear to enjoy very wide distribution. From the comparative lack of barriers on the sea floor and the uniformity of conditions there, this wide distribution is to be expected. In contrast, great ecological differences appear as one proceeds along a coast. To what extent do sponges spread along the littoral zone?

For approximately eight years I have been making a careful study of the sponges of California, particularly in connection with my treatise thereon published in the *Proceedings of the U. S. National Museum* (1932, No. 2927). It has since seemed desirable to acquire information as to the extent to which the ranges of the California species extend southward, but several personal trips into Mexican territory failed to yield suitable grounds for collecting sponges. After inquiry it appeared that The American Museum of Natural History in New York had in its possession a very interesting collection from Lower California, that is to say, Mexico, obtained by the Steamer 'Albatross' in 1911. Through the courtesy of Dr. Roy W. Miner and other officials of the American Museum, I have been permitted to study this collection, and I wish to express to them my appreciation for courtesies and assistance rendered in this regard.

Little comparison can be made with the Porifera of the west coast of South America, because the sponges of that region are probably the least studied of any in the world. The present collection consists chiefly of sponges manifesting one or the other of two types of relationships; either to those from the north of them in California, or to sponges of the Indo-Australian region. A few are quite novel, perhaps confined to the

immediate locality. Further remarks on this subject will be made in connection with the descriptions which follow.

The type specimens of all the new forms described below are deposited in The American Museum of Natural History, New York City.

NEW FORMS DESCRIBED

One new genus, *Hypsispongia*, is established, and eight new species and one new variety are described, as follows:

Lissodendoryx lara, new species

Asbestopluma biserialis, variety *californiana*, new variety

Orymycale paradoxa, new species

Hypsispongia popana, new genus, new species

Axinella mexicana, new species

Drumacidon ophisclera, new species

Aaptos vannahmei, new species

Laxosuberites mexicensis, new species

Choanites mineri, new species.

***Leucetta losangelensis* (de Laubenfels)**

Leuconia losangelensis DE LAUBENFELS, 1930, Stanford Univ. Bull., (5) V, No. 98, p. 25.

Leucetta losangelensis DE LAUBENFELS, 1932, Proc. U. S. Nat. Mus., No. 2927, LXXXI, Art. 4, p. 13.

In this, as in other specimens of the collection, the label merely indicates Lower California, in this case adding, "on oyster shells," no more precise locality being given. The Lower California specimen under discussion is very like the numerous specimens from upper California, except for a somewhat greater abundance of oscules and the corresponding cloacal cavities leading to the oscules.

***Haliclona ecbasis* de Laubenfels**

Haliclona ecbasis DE LAUBENFELS, 1930, Stanford Univ. Bull., (5) V, No. 98, p. 28.

This species was described from upper California. The specimen from Mexican waters is somewhat macerated, but in so far as it can be studied, it shows no significant point of difference from previously described sponges of this species.

***Xestospongia vanilla* (de Laubenfels)**

Haliclona vanilla DE LAUBENFELS, 1930, Stanford Univ. Bull., (5) V, No. 98, p. 28.

Xestospongia vanilla DE LAUBENFELS, 1932, Proc. U. S. Nat. Mus., No. 2927, LXXXI, Art 4, p. 116.

The specimen thus identified shows considerably more vertical growth than is common in specimens from upper California and somewhat greater abundance of larger oscules with more conspicuously developed rims about them. This is probably a reaction to current or the lack thereof, and is scarcely to be regarded as significant. This interesting species extends as far north as Puget Sound, according to my personal observation. It is to be regarded as a type of sponge very characteristic of the west coast of North America and is apparently little if at all represented by any very close relatives in other parts of the world.

***Lissodendoryx laza*, new species**

Figure 3

The holotype of this species is a small amorphous sponge about 2 by 2.5 by 2.5 cm.; another rather similar specimen occurs in the collection, presumably from a similar locality. The color as preserved in alcohol is a grayish drab; the consistency is very soft and compressible. The surface is somewhat uneven, but not especially rough or hispid. There is a very evident dermal membrane, though not readily detachable, because of its excessive thinness. In it the spicules vary from an erect position to one of being strewn in confusion. Pores and oscules cannot be made out with certainty. The endosomal structure is to be described as felted, but with strands, mostly parallel to each other, running perpendicularly to the surface. These are vaguely plumose and apparently contain some spongin. A diameter of approximately 100 μ might be assigned to them, although their outlines are so indefinite that this is only approximate. The special dermal spicules are tornotes which may be described as strongyles with unequal ends. Some of them have slight swellings at each end so that they approach the tylote condition. A characteristic size may be given as 9 μ by 600 μ . The endosomal spicules are tylostyles 17 μ by 700 μ . A very few of them have a few low spines on the heads. Apparently the microscleres consist exclusively of exceedingly abundant chelas, probably to be regarded as arcuate, although they approach closely the type known as palmate. Their length is about 50 μ .

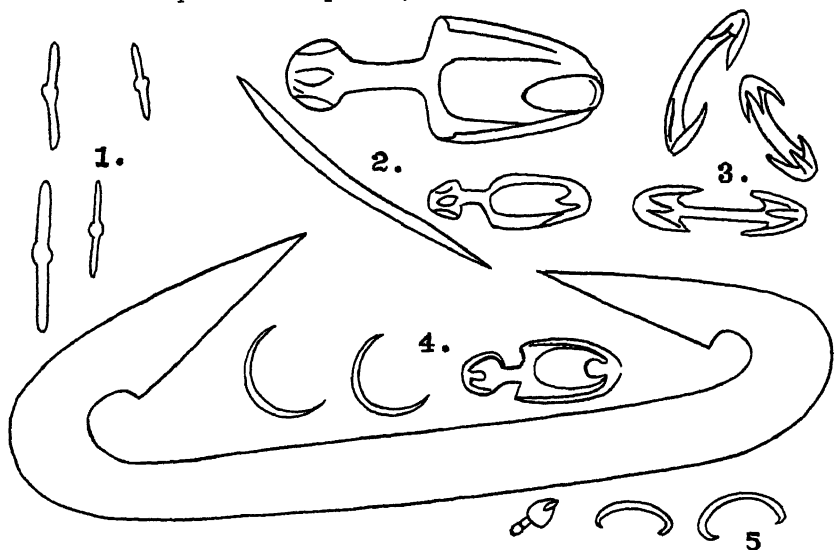
This species is remarkable for the tylostylote nature of the principal spicules and the lack of sigmas. Probably its closest relative is *Lissodendoryx balanophilus* Annandale (1914, p. 155) from India. This has smaller spicules all around and does have sigmas. Another sponge worthy of comparison here is *Lissodendoryx simplex* Topsent (1904, p. 173) a sponge from the Azores. It is very similar except that the principal spicules are simple styles instead of being tylostyles, and the chelas have a slightly different shape.

Type in The American Museum of Natural History, Cat. No. 243

***Acarus erithacus* de Laubenfels**

Acarus erithacus DE LAUBENFELS, 1927, Ann. Mag. Nat. Hist., (9) XIX, p. 258.

This interesting sponge is moderately common in upper California, so that it is not astonishing to find it occurring down into Mexican waters. The specimen under consideration is quite typical, having not only the so-called "palm-tree" spicules, but the "rose-stem" variety as well.



Figs. 1 to 5. Microscleres, from camera lucida drawings, $\times 666$.

1. Four centrotylote microstrongyles of *Choanites mineri*. 2. Larger and smaller anisochelas and microves of *Orymycale paradoxa*. 3. Three views of isochelas of *Lissodendoryx lara*. 4. Anisochela, sigmas and very large diacistra of *Hypispongia popana*. 5. Two sigmas and anisochela of *Asbestopluma biserialis* variety *californiana*.

Asbestopluma biserialis* variety *californiana*, new variety*Figure 5**

This species was first described by Ridley and Dendy (1886, Ann. Mag. Nat. Hist., (5) XVIII) as *Esperella biserialis*, from the south Pacific Ocean.

The specimen now under discussion has the "test tube cleaner" shape so distinctive of Ridley and Dendy's specimens. It is up to 14 mm. in diameter and at least 20 cm. long. It may have been longer before being broken by the collecting dredge. Its principal spicules are about $18\ \mu$ by $1150\ \mu$; its sigmas $22\ \mu$ in chord length; and its anisochelas only $6\ \mu$ long. This latter is the most conspicuous point of difference between the variety and the original species, which has anisochelas of twice or more the length of those in the Mexican form.

Type in The American Museum of Natural History, Cat. No. 250.

***Oxymycale paradoxa*, new species**

Figure 2

This specimen is a more or less amorphous mass, about 3 by 3 by 6 cm., and, judging from the specimen, it is not certain that it was attached at the time of collection; it may have been a so-called "roller" or loose sponge. The color, as preserved in alcohol, is pale drab, and the consistency is very spongy. The surface is rather uneven but not pronouncedly hispid. It is abundantly provided with openings about 1.2 mm. in diameter, or somewhat less. Which openings are inhalant and which exhalant is not readily made out. The interior is somewhat breadlike, very cavernous, the caverns being in the neighborhood of 1 mm. in diameter. The principal spicules are oxeas approximately $16\ \mu$ by $900\ \mu$. Very many are broken, and these doubtless include the largest ones; the maximum length therefore may have been considerably more than 1 mm. Among them are very few styles, somewhat smaller, about $10\ \mu$ by $420\ \mu$. The microscleres are extraordinarily abundant in number and variety. There are oxeote raphids about $4\ \mu$ by $110\ \mu$. There are a few sigmas about $30\ \mu$ in length of chord. There are some small palmate anisochelas $35\ \mu$ long, and very conspicuous large palmate anisochelas, some about $54\ \mu$ long, others as much as $120\ \mu$ long, the larger ones usually being aggregated into so-called rosettes.

The combination of monaxon principal spicules as in *Mycale* with diactines as in *Oxymycale* is a puzzling and perplexing situation. It is conceivable that one might establish a new genus for this form, but it hardly seems warranted. The oxeas are so clearly the predominant form, and it is so possible that the styles are malformed young spicules, that it is far from certain that this indicates any relationship of more than the most casual nature between *Oxymycale* and *Mycale*. The former genus is clearly indicated, although this is obviously a new species, with no very close relatives. The other form at present in *Oxymycale* was originally described as *Esperia intermedia* by Schmidt (1874, *Zweite deutsche Nordpolarfahrt*, p. 433). It has only oxeas as principal spicules, has only anisochelas for microscleres, and is an arctic species.

Type in The American Museum of Natural History, Cat. No. 251.

***Hypsispongia*, new genus**

This genus is established here for a species of the family Ophlitaspongiidae, having monaxon principal spicules and microscleres comprising palmate anisochelas together with diancistras. It happens that the one specimen so far described also possesses sigmas. The genotype will of course be this new species *Hypsispongia popana*.

***Hypsispongia popana*, new species**

Figure 4

The holotype is an amorphous mass about 3 by 8 by 11 cm. It is pale drab in color and very spongy in consistency. Its surface is comparatively smooth and even,

but there are meandering depressions to be made out. There is a very easily detachable special dermal structure over large subdermal cavities. This ectosome contains tangentially arranged spicules. The abundant surface apertures are approximately $120\ \mu$ in diameter and about $400\ \mu$ apart. Which, if any, are exhalant cannot be determined. The interior structure is somewhat "crumb-of-bread," that is to say, cavernous on a small scale. There are fibers which can be made out, but they are very confused as to pattern, and it can scarcely be said that there is any reticulation present. The approximate size of these fibers may be given as $100\ \mu$ diameter. They contain exceedingly numerous rows of spicules, and only dubious spongin. There is no special dermal category of spicules, the same kind being found in the ectosome as in the endosome. This sort is a hastately pointed style, varying from about $13\ \mu$ by $350\ \mu$ in $12\ \mu$ by $600\ \mu$. Among the most conspicuous spicules are the large diancistras. They do not have any considerable amount of alae as do those of some other sponges that have diancistras; their size is up to $250\ \mu$ long. There are enormously abundant thin sigmas, about $25\ \mu$ in chord length, frequently arranged in bundles resembling trichodragmas. There are very abundant palmate anisochelas about $40\ \mu$ long, and others also fairly common and of similar shape but more than twice as large, say $85\ \mu$ in length, which latter are arranged in rosettes.

In addition to the holotype (American Museum of Natural History, Cat. No. 262), there is a second rather similar specimen in the collection. The combination of diancistras with palmate anisochelas is quite peculiar and constitutes the most distinguishing mark of the genus and species.

Hemectyon hyle de Laubenfels

Hemectyon hyle DE LAUBENFELS, 1930, Stanford Univ. Bull., (5) V, No. 98, p. 28.

Very much like the specimen previously described from upper California, this also is a fantastically irregular subramose sponge. It closely agrees in other ways with the previously described specimen.

Axinella mexicana, new species

Figure 6

The holotype is a thinly encrusting mass, about 1 by 1 by 2 cm. in dimensions. The color is drab, and the consistency is between spongy and fragile, so much so that it breaks and tears with very great ease. As to surface structures, it resembles *Acarnus erithacus* (above mentioned) in that to the naked eye there are evidently great masses of plumose ascending columns, all of approximately the same height. Looking down upon such a sponge with a magnifying glass is very like seeing a coniferous forest from the air. The pores are to be interpreted as represented by the interstices between the treelike columns. There are obvious oscules, about one per square centimeter, and each about 1 mm. in diameter. The internal structure has already been described above in the comparison to a pine forest. The plumose fibers are slightly more than $150\ \mu$ in diameter. The principal spicules are monaxons, usually about $20\ \mu$ by $300\ \mu$, but rather frequently reaching $24\ \mu$ by $400\ \mu$. It is characteristic of these that they are sharply bent at a point about one-fifth of the total length of the spicule away from the blunt end. Among them are oxeas, almost

as numerous, usually about $27\ \mu$ by $360\ \mu$, although occasionally smaller, say only $16\ \mu$ by $400\ \mu$. These are about almost invariably bent at approximately the midpoint of the spicule.

Probably the most remarkable thing about this species is the fact that the oxeote spicules exceed in size the stylote. However, there are at least two other species in the genus *Axinella* of which this is true. *Axinella sanguinea* described from South Africa by Burton (1933, p. 253) has this characteristic, but its spicules are very much smaller than those of the Mexican form at present under discussion. The oxeas are only $11\ \mu$ by $211\ \mu$, and the styles only $7\ \mu$ by $140\ \mu$. Another sponge having this unusual characteristic was described from the Azores as *Axinella vasonuda* by Topsent (1904, p. 140). Its spicules are enormously larger than those of the Mexican form, the oxeas being $50\ \mu$ by $1500\ \mu$ and the styles $20\ \mu$ by $1000\ \mu$. Another *Axinella* that is probably even closer than either of these two is that which was first described by Esper (1794, p. 275) as *Spongia verrucosa*. Its styles and oxeas are almost exactly the size and shape of the Lower Californian sponge, although the styles tend to be larger and the oxeas smaller, but in addition to them it possesses strongyles, is ramose, and has a very pronouncedly verrucose surface. Since the form under discussion lacks all three of the characteristics last mentioned, it seems advisable at present to establish a new species for it.

Type in The American Museum of Natural History, Cat. No. 261.

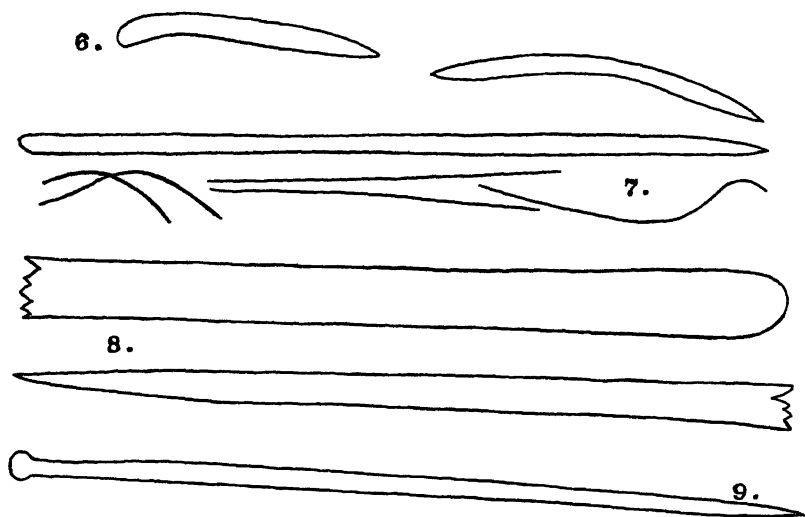
Drarmacidon ophisclera, new species

Figure 7

The holotype of this species is flat above, convex below, about 2 cm. thick, and its lateral dimensions are approximately 5 by 7 cm. It is pale drab in color as preserved in alcohol, and very spongy in consistency. The surface is rather smooth and even, and shows a clearly demarked special dermal membrane. Microscopic study reveals that this is packed with spicules chiefly erect, that is to say, perpendicular to the surface. The pores and oscules cannot be made out with certainty. The internal structure shows obvious fibers in rather confused reticulation. These tracts or fibers are about $150\ \mu$ in diameter. The commonest type of spicule present is the style, $25\ \mu$ by $1200\ \mu$, but very many of the spicules are oxeote in shape, and these, although almost as thick as the styles, are remarkably shorter, say $23\ \mu$ by $650\ \mu$ only. Among these larger spicules are enormous numbers of very thin spicules occasionally straight, but more often sinuously bent, each having several rounded undulations. The variation in length is enormous. The thickness of each is approximately $1\ \mu$ only. $150\ \mu$ might be cited as an average length, but certainly the variation is at least as great as from $50\ \mu$ to $500\ \mu$. Perhaps most or all have been broken since collection or even before that time, during the life of the sponge. Occasionally these are arranged in bundles as are the spicules referred to as trichodragmas.

It is the presence of these peculiar serpent-shaped thin spicules that sets off the present species sharply from all others. There are no close relatives, and in fact it is conceivable that a new genus might be erected for this form, but otherwise the relationship to the genus *Dragmacidon* is sufficiently close to make such a step unwarranted at present.

Type in The American Museum of Natural History, Cat. No. 260.



Figs. 6 to 9. Megascleres, from camera lucida drawings, $\times 150$.

6. Style (at left) and oxea (upper right) of *Arinella mexicana*. 7. Style (above) and five rhabdites of *Dragmacidon ophisclera*. 8. Head of style (above) and pointed end of style (below) of *Aaptos vannamei*. 9. Tylostyle of *Lazosuberites mexicanensis*.

Aaptos vannamei, new species

Figure 8

The holotype of this is a symmetrical sponge with a base about 2 by 7 cm. and an altitude of about 4.5 cm. There is nothing distinctive either as to its color or consistency, it being moderately compressible and easily torn. There is a distinct cortex about 800μ thick containing so many and such pronouncedly erect spicules that the surface is to be described as hispid. Many of the above-mentioned spicules protrude as much as 4 mm. from the surface. The pores cannot be made out with certainty, but the exhalant aperture is quite remarkable. In general the sponge may be described by comparison with a cone or miniature volcanic mountain. If it be placed with the apex upward, the spicules that hispidate the surface will be found to point directly away from the substratum rather than perpendicular to the slanting slopes of the hill. At the apex there is a crater about 1 cm. in diameter which does not possess hispidating spicules of large size, although with a microscope it is found to be packed with erect spicules of very small size. It is in general concave in shape, but near its center there rises a second little cone only 2 or 3 mm. high, the walls of which are

chiefly protoplasmic or fleshy. This ascends to the oscule proper, which has a diameter in the preserved specimen of barely 1 mm., but presumably might be opened to a greater size in life. From it a cloacal chamber extends downward into the sponge with smaller and smaller branches until it is dissipated throughout the internal structures. There are two distinct categories of spicules present. First there are very abundant thin styles or subtylostyles, all approximately 5 μ in diameter and varying considerably in length; 500 μ to 600 μ may be cited as representative of the latter dimension. The other category is of styles varying from 60 μ by 3600 μ to at least 120 μ by even greater length. The longest are usually broken, but it may safely be assumed that they exceeded 5 or 6 mm. before being damaged.

The very noteworthy external form of this sponge is perhaps that which distinguishes it most satisfactorily from all others. The type of the genus, originally described as *Ancorina aaptos* by Schmidt (1864, p. 33), from the Mediterranean, had both its categories of styles considerably smaller than those of the Mexican species at present under consideration.

The species is named for the eminent zoölogist, Dr. W. G. Van Name, of The American Museum of Natural History, New York City.

Type in The American Museum of Natural History, Cat. No. 255.

***Laxosuberites mexicensis*, new species**

Figure 9

The holotype of this species encrusts an enormous spicule from a sponge of the class Hyalospongiae (Hexactinellidae), which spicule is more than 1 mm. thick, and more than 150 mm. long. The encrustation is not spread uniformly along this spicule, however, but is wedge-shaped, or triangular, extending in one place more than 1 cm. away from the hexactinellid spicule, and at the greatest being less than 2 cm. in dimensions parallel to said spicule. Its color is drab; its consistency soft; the surface is minutely hispid; pores and oscules cannot be made out with certainty. The internal structure is in general rather confused, but right at the surface there are bouquets of spicules with the points toward the surface. These are not, however, conspicuously smaller than those of the endosome, but instead all the megascleres may be quoted as of but a single size range, namely, approximately 20 μ by 1000 μ . They are all tylostyles.

The structure is clearly that of *Laxosuberites*, but it is interesting to note that the sponge in other respects most like the one under discussion is a member of the genus *Prosuberites*, described from the Mediterranean as *Prosuberites longispina* by Topsent (1894, p. xlii). In upper California there is recorded by de Laubenfels (1930 p. 26) a sponge under the name of *Prosuberites sisyrnus*; this, however, bears only slight resemblance to the Mexican form under discussion, for example, having its tylostyles only 8 μ by 27 μ to 20 μ by 480 μ . The combination of relatively enormous spicules in the *Laxosuberites* type of structure is perhaps the most

characteristic item in regard to the sponge at present under discussion.

Type in The American Museum of Natural History, Cat. No. 242.

***Suberites durissimus* Ridley and Dendy**

Suberites durissimus RIDLEY AND DENDY, 1886, Ann. Mag. Nat. Hist., (5) VIII, p. 486.

This species was described from Australia. The form under discussion at the present time bears no distinctive point of separation from the Australian form but may be described briefly for purposes of comparison, if such seems necessary.

It is subspherical, about 1 cm. in diameter, drab, toughly compressible, having an even surface, which is lipostomous. The internal structure is between radiate and semiplumose. The special dermal tylostyles are approximately $4\ \mu$ by $300\ \mu$ and the endosomal ones $18\ \mu$ by $1200\ \mu$. Some sand with other foreign material is present.

***Choanites mineri*, new species**

Figure 1

This interesting sponge has the shape of a shallow cup, about 4 by 8 cm., with walls 2 cm. thick, and the depression only a little over 1 cm. deep. Perhaps the comparison should rather be made to a saucer than to a cup. The color is drab and the consistency firm, almost cartilaginous, easily cut. There is an evident ectosomal specialization about $180\ \mu$ thick which might perhaps be called a cortex. The surface is very even, but with a microscope is seen to be packed with erect spicules. The surface is abundantly provided with openings about only $50\ \mu$ in diameter and about $110\ \mu$ apart, center to center. Which of these openings, if any, are to be described as oscules, is not apparent. The internal structure is astonishingly free from any semblance of radiate architecture; instead it is more like that of "crumb-of-bread." There are abundant canals about $100\ \mu$ in diameter or gross chambers of the same size. These cavities are so abundant that they are only $250\ \mu$ apart, center to center. The arrangement of the spicules is restricted to inclusion in the relatively small amount of flesh about these canals and chambers. In the protoplasmic walls they are arranged more or less in confusion. The megascleres are of one sort only—tylostyles—approximately $10\ \mu$ by $340\ \mu$, the erect dermal ones being of the same size as those in the endosome. Among them is an abundance of microscleres, which abundance is very uncommon in the order Hadromerina. These are quite typical of the genus *Choanites*, being centrotyle microstrongyles. The typical size is $2\ \mu$ by $30\ \mu$; some are as small as $1\ \mu$ by $18\ \mu$, and a few as large as $3\ \mu$ by $36\ \mu$.

This is a very decisively characterized species apparently having no close relatives at present described, and possibly even deserving of a new genus. The fact that the ectosomal spicules are the same size as those in the endosome is distinctly different from what would be expected in typical *Choanites*. The lack of radiate structure and the great abundance of the microscleres has already been thought worthy of comment above, and the fact that these microscleres are frequently curved is not at all common.

This species is named for the eminent zoölogist, Dr. R. W. Miner, of The American Museum of Natural History, New York City.

Type in The American Museum of Natural History, Cat. No. 248.

***Tethya aurantia* (Pallas)**

Alcyonium aurantium PALLAS, 1766, 'Elenchus Zoophytorum,' p. 210.

Tethya aurantia TOPSENT, 1900, Arch. Zool. Exp., (3) VIII, p. 294.

This species has already been recorded by numerous authors from practically every part of the world, and for this reason it is not astonishing to find it in Lower California. It has previously been recorded from upper California by de Laubenfels (1932, p. 44). The specimen from Mexican waters differs in no important respect from those found in upper California, and, for that matter, in other parts of the world.

***Topsentia glabra* (Topsent)**

Anisoxya glabra TOPSENT, 1898, Mém. Soc. Zool. France, XI, p. 234.

Topsentia glabra BERG, 1899, III, Comm. Mus. Nac. Buenos Aires, I, pp. 77-80.

This species was described from the Azores and later made type of the genus *Topsentia*. It is rather unexpected that the sponge from the west coast of North America should have its closest relative in the Azores, so a very brief description of the Mexican sponge is here appended.

It is lamellate, about 1 cm. thick and 8 cm. square. The color is pale drab, and the consistency is friable to stony. The surface is minutely hispid, well provided with apertures up to 1 mm. in diameter, some of which are probably oscules and others pores. The megascleres are large oxeas $16\ \mu$ by $530\ \mu$ to $19\ \mu$ by $940\ \mu$, among which are found microxea only $4\ \mu$ by $105\ \mu$.

This does not differ in any significant respect from the previously described Atlantic species. It does not even seem advisable at present to erect a subspecies for it.

***Tetilla mutabilis* de Laubenfels**

Tetilla mutabilis DE LAUBENFELS, 1930, Stanford Univ. Bull., (5) V, No. 98, p. 26.

This was originally described from upper California. There is no significant point of difference between the Californian species and the Mexican one at present under discussion, except that the latter has a shape that is not the most common farther north. It is cone-shaped, the apex evidently having been upmost, and the base affixed in sand.

Craniella arb (de Laubenfels)

Tetilla arb DE LAUBENFELS, 1930, Stanford Univ. Bull., (5) V, No. 98, p. 26.

There is no considerable amount of difference between the specimen previously described from upper California and this one herein recorded from Lower California.

Craniella dactyloidea (Carter)

Tethya dactyloidea CARTER, 1869, Ann. Mag. Nat. Hist., (4) III, p. 15.

This sponge was originally described from Arabia. It has since been recorded from the Philippine Islands by Wilson (1925, p. 358). Its distribution is perhaps circumequatorial, because this example from the west coast of North America differs in no striking way from the Philippine and Indian Ocean specimens.

It is an erect cylinder, 4 mm. in maximum diameter, 16 mm. high, with one apically placed oscule or cloaca. There are abundant, very long, usually broken oxeas $4\ \mu$ in diameter, and some protriaenes of the same size range. There are very thin oxeote spicules less than $1\ \mu$ in diameter, slightly more than $100\ \mu$ long, and small sigmoid spicules less than $1\ \mu$ thick, and $10\ \mu$ in chord length.

Pachastrella monilifera Schmidt

Pachastrella monilifera SCHMIDT, 1868, 'Die Spongien der Küste von Algier,' p. 15.

This species is already well known to be cosmopolitan, so there is nothing surprising in its discovery on the Pacific coast of North America.

It was originally described from the Mediterranean, and the original description might do well for the specimen in the collection at present being studied.

Chondrilla nucula Schmidt

Chondrilla nucula SCHMIDT, 1862, 'Die Spongien des adriatischen Meeres,' p. 39.

This species was originally described from Europe. Wilson (1902, p. 386) recorded it from the West Indies, and Burton (1924, p. 206), from Australia. It also is probably circumequatorial in distribution, as this Mexican record would seem to indicate.

This is a fleshy encrusting sponge about 1 cc. in volume, 1 sq. cm. in area, and 2 or 3 cm. thick, dark drab in color and cartilaginous in consistency, smooth even surface, lipostomous, aspiculous.

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NOTES ON SOUTH AMERICAN MAMMALIA.—No. 1.
SCIURILLUS

BY H. E. ANTHONY AND G. H. H. TATE

The receipt of more than thirty specimens of this rare genus of squirrels from native field collectors working in Brazil for the American Museum has prompted us to go over the rather scanty literature and survey the status of *Sciurillus*.

Miss Barbara Lawrence, of the Museum of Comparative Zoölogy, Cambridge, Mass., upon learning that we have had the present paper in hand for some time, has generously turned over to us notes prepared by her on the taxonomy of the forms of *Sciurillus*, which she based upon three specimens from the Tapajoz region and three from French Guiana (loaned to her by the Field Museum). We are further indebted to Miss Lawrence for informing us of the presence of these three specimens of true *pusillus* from French Guiana in the collection of the Field Museum. And to Dr. W. H. Osgood, who has loaned us the three animals just alluded to, we wish to express our thanks.

A South American pygmy squirrel was definitely described by Buffon (1789)¹ under the name "le petit guerlinguet," and by Desmarest (1817) it was given the technical specific name *pusillus* and placed in the blanket genus *Sciurus*. No further constructive mention of the animal appeared for half a century until Gray (1867) redescribed *pusillus* (he had a specimen in the British Museum), described *Macroxus kuhlii* (based upon a specimen purchased by the British Museum with the Castelnau collection), and transferred *pusillus* Desmarest to *Macroxus*. A decade later Allen (1877) concluded, not solely from the literature,² that *pusillus* and *kuhlii* were not only synonymous with one another but merely juveniles of *aestuans*.

The first hint that these tiny squirrels ought to be generically separated from *Sciurus* appeared when Alston (1878) drew attention to

¹In Buffon (1776 and 1777) there appears a vague allusion, possibly to this squirrel: "... says that there is in Guiana only a single species of squirrel, which lives in the woods, that its fur is reddish, and that it is no larger than the rat of Europe, that it lives on seeds of Maripa . . . that it produces its young, two in number, in holes in trees. . . ." In 1789, however, Buffon distinguished and described the "grand guerlinguet" and the "petit guerlinguet" both from Guiana. The latter became *Sciurillus pusillus*. We feel that the original description should be taken as from 1789.

²"I have before me another, from Brazil, which I believe to be only a very young example of *S. aestuans*, although in size and coloration it agrees perfectly with the descriptions of *S. pusillus*." [Allen, 1877, pp. 759-760.]

the additional premolars of *pusillus* material from Guana and of *kuhl*i (which he held to be a synonym of *pusillus*). He stated then that he had failed to find the type of *pusillus* in the Paris Museum. Allen (1878), accepting Alston's views, promptly admitted the distinctness of these squirrels from *aestuanus*.

Another quarter of a century passed before Thomas (1914*a*, *b* and *c*) was induced by the receipt of new material from British Guiana to re-examine the British Museum specimens. A few years before (1909) he had worked out the genera of African squirrels and this fact doubtless led him to compare the skulls of *pusillus* and *kuhl*i with those of *Nannosciurus* of Malaysia and *Myosciurus* of West Africa. As a result he set up the new genus *Sciurillus*, with type *pusillus*, and declared it most nearly allied to the above two genera. Writing under the heading of *Microsciurus* a few months earlier, Allen (1914) had apparently entertained no suspicion of the above facts, but without having seen either, had separated *pusillus* and *kuhl*i widely. The next year however Thomas, basing his conclusions on the divergent structure of the os priapi of *Myosciurus* and *Nannosciurus*, judged his own subfamily *Nannosciurinae* to be artificial. Pocock (1923) also denied relationships of *Myosciurus* and *Nannosciurus*, considering their common characters the result of convergence.

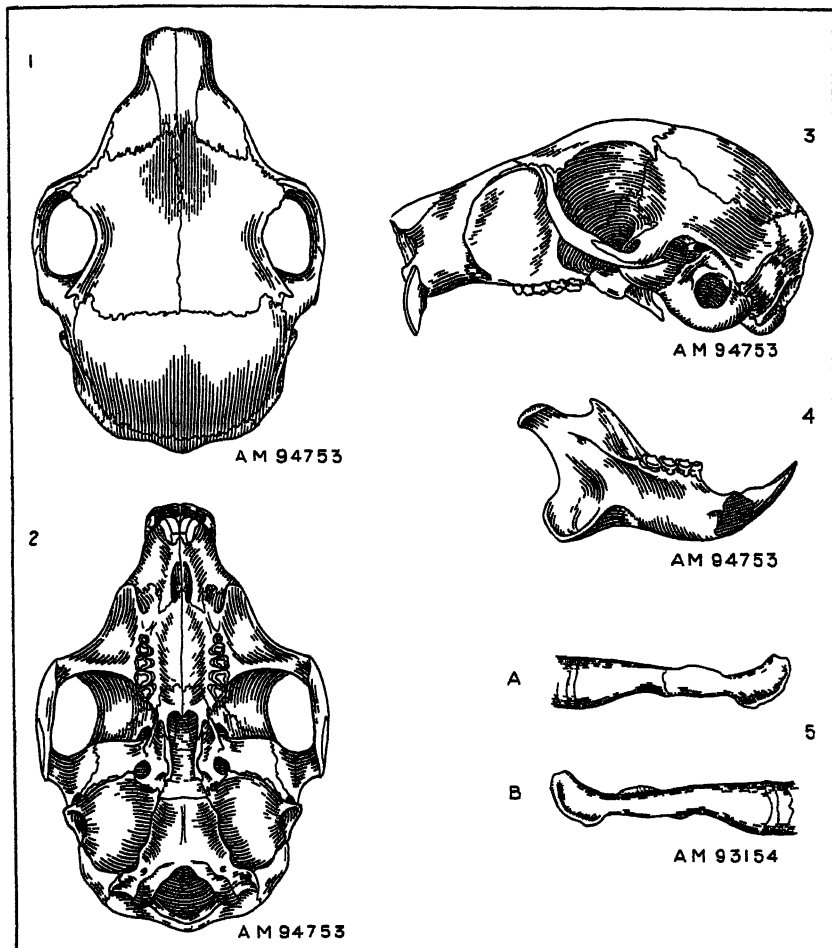
Of great geographical interest was Thomas's (1928) receipt of two specimens from Pebas, on the upper Amazon in eastern Peru, which he mentioned under the name *pusillus*. In consequence of that discovery, he suggested that the type of *kuhl*i, supposed to have been collected by Castelnau, might well have been obtained at Pebas.

By recent writers on the anatomy and taxonomy of the Sciuridae, Pocock (1922, 1923), Weber (1928), Frechkop (1932), *Sciurillus* seems to have been wholly ignored. This is probably due more to its great scarcity in collections than to the assumption that it is synonymous with *Microsciurus*. Pinto (1931) includes *Sciurillus* in his key to genera, but fails to record *pusillus* as a member of the Brazilian squirrel fauna.

From the foregoing general résumé of the systematic standing of *Sciurillus*, one is left with the impression that Thomas's (1914) paper pointing out some of the generic characters of the genus was based upon defective evidence. The difference between the bacula of *Myosciurus* and *Nannosciurus* (and, by implication, of *Sciurillus* whose baculum has never, so far as we know, before been examined),¹ this single character

¹We have had the baculum of No 93154 extracted and cleaned and present herewith a line drawing of it (Fig 5). It appears to be of relatively simple structure, in no way resembling illustrations of those of *Nannosciurus* (Pocock, 1923, p 223, text-fig 22, H, I, K). Rather it seems nearest to that of *Sciurus niger* (p 215, text-fig 19, A, B). This fact, if reliance is to be placed upon differences in form of the baculum, tends to separate *Sciurillus* from *Nannosciurus*.

difference, we are urged to believe carries far greater weight than the not inconsiderable number of quite remarkable resemblances which we list beyond, briefly dismissed by Pocock (1923, p. 212) as "convergent



Figs. 1 to 5 Views of skull and of os priapi of *Sciurillus pusillus*.
 1, dorsal view, 2, ventral view, 3, lateral view, 4, lateral view of inner face of mandible, all four $\times 2$, 5, os priapi, \times about 7, A, seen from left side, B, seen from right side

characters." Furthermore, considering the number of cases of discontinuous distribution which have been satisfactorily explained (for example, the tapirs and hystricomorphs), the geographical discontinuity

between Malaysia and South America offers no serious barrier to the idea of true relationship between *Sciurillus* and *Nannosciurus* (we have seen no examples of *Myosciurus*). In support of this conception of such a relationship, the following table illustrates important differences between *Nannosciurus* and *Sciurillus* (taken together) and representative species of *Sciurus*, such as *vulgaris*, *carolinensis*, and *hoffmanni*. The divergent characters of the two pygmy genera are at least in part the result of extreme shortening of the base of the skull combined with a strong arching tendency. It will be noted that in certain respects *Microsciurus* holds an intermediate position.

COMPARISON OF SKULLS OF "NANNOSCIURINE" SQUIRRELS WITH
SCIURINE SQUIRRELS

<i>Sciurillus</i> and <i>Nannosciurus</i> (borneanus)	<i>Sciurus vulgaris, carolinensis</i> , etc.
1. Great interorbital breadth: $\frac{\text{interorbital breadth}}{\text{length of frontal}}$ approximately 1.	1. $\frac{\text{Interorbital breadth}}{\text{Length of frontal}}$ definitely less than 1.
2. Great development of pterygoid wings of alisphenoids [the "ectopterygoids" of Thomas (1914, p. 416)].	2. Slight development of same.
3. Circular form of the orbitotemporal fossa with displacement of the zygomatic process of the squamosal forward to lie below the postorbital process of the frontal.	3. Elongate-oval form of orbitotemporal fossa. No displacement forward of zygomatic process of squamosal.
4. A much greater separation of the frontal process of the premaxilla from the lacrimal by means of a broader contact between maxilla and frontal. Extrusion of greater part of lacrimal into margin of orbit.	4. Only moderate separation of lacrimal from frontal process of premaxilla by contact of frontal with maxilla. But in <i>Microsciurus</i> the condition is as in <i>Sciurillus</i> . Greater part of lacrimal withdrawn from orbit and lying between frontal and zygomatic process of maxilla.
5. Viewed from the side, the area of maxilla representing the origin of the infraorbital part of the masseter considerably exceeds the area of the lateral face of the premaxilla just anterior to it.	5. This area of portion of maxilla distinctly less than that of premaxilla anterior to it.

<i>Sciurillus</i> and <i>Nannosciurus</i> (<i>borneanus</i>)	<i>Sciurus vulgaris</i> , <i>carolinensis</i> , etc.
6. A pronounced flange or ridge crossing the orbital surface of the alisphenoid from the base of the zygomatic process of the squamosal to the origin of external pterygoid muscle. Also inflation of that part of the alisphenoid anterior to the bulla.	6. Such a ridge nearly or quite absent. No inflation of alisphenoid, just anterior to the bulla (except in <i>Microsciurus</i> , in which both characters are incipient).
7. Upper incisors strongly proödont.	7. Upper incisors normal (proödont in <i>Microsciurus</i>).
8. Coronoid process of mandible reduced in <i>Sciurillus</i> , approaching obsolescence in <i>Nannosciurus</i> .	8. Coronoid process of mandible present and normal (except <i>Microsciurus</i>).
9. Articular process of mandible attenuate, drawn backward to form a hook.	9. Articular process not so formed.

In the succeeding table we point out some of the differences between the skulls of *Sciurillus* and *Nannosciurus*. All of these differences, except numbers 3 and 5, it will at once be noted are of a smaller order of magnitude than those described in the previous table.

<i>Sciurillus</i>	<i>Nannosciurus</i> (<i>borneanus</i>)
1. Paroccipital processes normally developed.	1. Paroccipital processes almost obsolete.
2. A medial palatal projection backward into pterygoid fossa.	2. No such projection of palate.
3. Baculum most nearly similar to that of <i>Sciurus niger</i> .	3. Baculum hinged and hook-shaped.
4. Insertion area for internal pterygoid muscle a deeply excavated fossa.	4. Insertion area for internal pterygoid not so deeply excavated.
5. Jugal a slender element with no postorbital process, articulation with squamosal very extensive.	5. Jugal proportionally broad, with noticeable postorbital process, articulation with squamosal restricted to less than half the posterior extent of jugal.

The above facts confirm, in most respects, Thomas's original conception of the generic position of *Sciurillus*, although the case is still open

to some doubt as to the exact degree of relationship between *Sciurillus* and *Nannosciurus*.

From the distributional standpoint, *Sciurillus* is now recorded from the Guiana coastal strip; from our newly worked west Tapajoz region on the south bank of the Amazon, all the localities of which will go into a circle 200 miles in diameter; and from the Ucayali drainage basin in eastern Peru. (See map, Fig. 6.) From the standpoint of taxonomy we appear to be dealing with a monotypic genus which may or may not be susceptible of division into slightly differentiated geographical races.

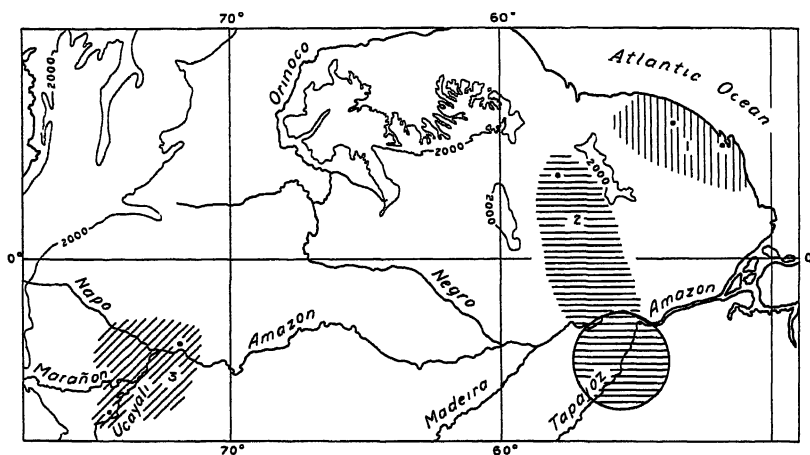


Fig. 6. Map showing the distribution of *Sciurillus*.

Dots represent single localities and the circle encloses a number of locality records of the Tapajoz area. Shaded areas mark the suggested distributions of the three subspecies of *pusillus*: 1, *S. pusillus pusillus*; 2, *S. pusillus glaucinus*; 3, *S. pusillus kuhlii*.

A discussion of this question of geographical races is pertinent in view of material now available.

Three specific or subspecific names have been applied to squirrels of the genus *Sciurillus*—*pusillus*, *glaucinus*, and *kuhlii*, the first two to animals from French and British Guiana, the last to those from eastern Peru. The type locality of *glaucinus* alone is definite—Great Falls of Demarara River, British Guiana. The type locality of *pusillus* may be considered restricted, according to Desmarest's (1817) suggestion, to Cayenne, French Guiana. Thomas's *glaucinus* from 400 miles west of Cayenne was separated from *pusillus* mainly on the basis of its much paler coloring, and we may infer that he had before him true *pusillus* for

comparison, from his mention of the "greyish hair brown" and "dark grey washed with fulvous" body color and the "almost ferruginous" color of the head of *pusillus*. Even he, however, makes no mention of the white postauricular patches of true *pusillus*, though he does write of them when describing *glaucinus*. This feature, also characteristic of *kuhlii*, is present (rarely slightly suppressed) in every one of our series from the Tapajoz region, as well as in what we consider to be typical *pusillus*. Neither Buffon nor Desmarest mentioned these white patches when describing the species. Gray (1867) implied that the British Museum specimen, or specimens, lacked the whitish ear patches and Alston (1878) speaks of two specimens in the British Museum from which *kuhlii* differs in having these patches. In the Field Museum specimens, which are virtually topotypes of *S. p. pusillus*, since they come from the Mana River some 80 miles west of Cayenne, the light-colored ear patches are found well-developed. We are puzzled as to the exact status of these British Museum pigmy squirrels which lack the light-colored ear patches. Specimens of *Microsciurus* should not have been confused with those of *Sciurillus* by Gray and Alston (although the former genus was not recognized at that time) and no specimens of this group have ever been collected very far east of the slopes of the Andes. Possibly later collecting will disclose a Guiana *Sciurillus* which consistently lacks these patches, but the material now at hand implies the contrary.

A character of some importance, not noted earlier than in Miss Lawrence's manuscript, is the color of the outer tips of the ears of the French Guiana squirrels, which is quite black, and the decidedly reddish shade of the head anterior to the ears. In all other material seen by us, the ears and head are colored externally nearly like the body.

Material examined by us:

French Guiana: Tamanoir, Mana River	2 ♂	Skin and skull (without lower jaws)
	1 ♀	Skin and skull
Peru: Sarayacu, Rio Ucayali	1 ♂	Skin and skull. Collected 30 March, 1927
Brazil (south bank of R. Amazon):		
Between R. Madeira and R. Tapajoz:		
Lago Andira, near Villa Bella		
Imperatriz	2 ♂	Skins with the bodies in alcohol. Collected September, 1930
Boca Rio Andira, near Villa Bella		
Imperatriz	1 ♂	Entire in alcohol
	♀	Skin, body in alcohol. Collected October, 1930

Lower Rio Tapajoz

(left bank, between Boim and mouth):

Igarapé Brabo	9 ♂	Skins and skulls
	7 ♀	Skins and skulls. Collected June, 1931
Igarapé Amarin	1 ♂	Skull only
	1 ♀	Skin and skull. Collected June, 1931
Limoal (on Igarapé Amarin)	7 ♂	Skins and skulls
	1 ♀	Skin and skull. Collected July, 1931
Limontuba (on Igarapé Amarin)	2 ♂	Skins and skulls
	1 ♂	Skin only. Collected August, 1931

Total material: 37 specimens.

In the table following this paper the few measurements that have been published in descriptions are compared with those of a representative set of specimens from our new series and those of the three *p. pusillus* from French Guiana. To facilitate this comparison we have adopted the same set of cranial measurements as were used by Thomas in his description of *glauцинus*. The study is valuable only for its demonstration of the great structural uniformity of these squirrels. Even sexual deviations are at a minimum. Nor by direct comparison of the skulls at hand have we succeeded in finding any but inconstant or individual differences. Length of pelage is of very doubtful value,¹ since nothing is known about the molt of pygmy squirrels and, in any case, difference in the length of the fur, even when correlated with distribution, is likely to be merely a somatic phenomenon.

Only color differences remain for consideration. On the basis of their black-tipped ears and reddish heads the French Guiana material can at once be separated from the remainder. The male and female recorded by Thomas (1928) from Pebas were not described. The long series of material from the Tapajoz agrees closely with Thomas's description (1914c) of *glauцинus*. And finally, our individual (a male) from Sarayacu, 300 miles southwest of Pebas, is somewhat more saturate than our Tapajoz material, having the belly even more cinnamon than the hazel of *p. pusillus* and the back slightly darker. Its head is similar in color to the body, being only slightly tinged with rufous about the muzzle. The hairs of the tails in Guiana and Tapajoz material are much less full than are those of our Sarayacu animal, the former being some 14 mm. in length, taken along the side of the tail, and the latter 17 mm.

In conjecturing the identity of *kuhlii*, we may compare Gray's description with our known material as follows: "fur soft, nearly uniform

¹Except perhaps that of the tail. See beyond.

olive, slightly washed with yellowish." Compare with "neutral gray" of *glaucinus*. Our Tapajoz animals may be placed in color between drab and hair brown, but with a slightly yellowish wash, and the Sarayacu animal is near hair brown with a deeper overwash near honey yellow or tawny olive. "Chin and under sides rather paler and yellower" (Gray) may be contrasted with "pale gray washed with light buffy" (*glaucinus*) and with chaetura drab washed with hazel, slightly deeper for the Sarayacu animal than for the Tapajoz series. "A white spot above the base of each ear" (common to all). "Tail blackish, whitish washed; hairs yellow, with a broad subterminal band and white tip" (Gray). Of *glaucinus* Thomas wrote: "Tail hairs tipped with whitish, a number of hairs in the terminal pencil black, a line along the center below also black." In all material before us, the hairs of the tail are made up of three kinds: whitish hairs with black tips, black hairs with whitish tips, and black hairs with a whitish subterminal band, the tip again becoming black. Various proportions of these three can easily account for differences in descriptions. We find little difference between the tails of *p. pusillus* of French Guiana and the animals from the Tapajoz, except a slight deepening of the yellow-white tone in the former. The pencil hairs of the Tapajoz form reach 23 mm. in length, of true *pusillus* 33 mm., and of our Sarayacu specimen whose tail is unusually short, possibly deformed, over 60 mm. in length. This last may also be due to injury and consequently is without value for purposes of taxonomy.

The "olive" back (of Gray) fits either the French Guiana or the Peruvian animal more closely than either typical *glaucinus* or the Tapajoz form. "Rather paler and yellower" (than the dorsum) agrees only imperfectly with any of the squirrels before us. "Hairs (of the tail) yellow," etc., harmonizes rather well with our Sarayacu specimen, at least in regard to the hairs of the proximal half of the tail. On the basis of the above comparison, then, we would refer our specimen from Peru to *kuhlîi*, and our long series from the Rio Tapajoz we incline to place with *glaucinus*, on account of the generally paler and grayer dorsal coloration, for although we have had no opportunity to have them compared with typical material, we can find no point of divergence from the description of *glaucinus*, except that we would not describe the white of the ears and ear patches as "snowy."

As for the source of the type of *kuhlîi*, it was marked "Brazil (Castelnau)" by Gray. Thomas (1914b and c) implied that it had been mixed with Castelnau material by the dealer Parzudaki and really came from Guiana. Years later (1928), after receiving material from Pebas,

he reversed his former opinion and suggested that Castelnau might after all have taken the type in the upper Amazon region.¹

Thus the type locality of *kuhlii* remains doubtful. But in view of the fact that the type of *kuhlii* seems to have been a fairly dark animal with the tail hairs yellow at the base, and that it may have been collected by Castelnau, we incline, in the absence of evidence to the contrary, to restrict its type locality to Pebas, referring our squirrel from Sarayacu to *kuhlii*. And tentatively we leave *Sciurus pusillus* as three geographical races (all with light-colored ear patches):

<i>Sciurillus pusillus</i>	Cayenne	A brown squirrel with reddish head and the outer surface of the ears black
<i>Sciurillus pusillus</i>	Eastern Peru	A brown squirrel with ears colored as head. Under parts washed with deep hazel. Tail hairs relatively long (at sides of tail 19 mm.)
<i>Sciurillus pusillus glaucinus</i>	Demarara and the Tapajoz region	A gray-brown squirrel with ears colored as head. Under parts washed with light hazel. Tail hairs relatively short (at sides of tail 15 mm.)

BREEDING HABITS.—The following notes on breeding habits of the Tapajoz form, taken from field labels, indicate that June is at least one of the important breeding months and that normally two young are born at a time. Four females from Igarapé Brabo were marked as having two embryos; one female from Igarapé Amorin was shown to have one embryo. All of these specimens were taken in June. A female from Limoal in July and another from Boca de Andira in October were not labeled as having embryos. A single female from Igarapé Brabo collected in June was marked "6 mammae with milk." On the backs of the labels the local name is shown as "Cuatipuruzinho."

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¹In Castelnau's 'Expedition dans les parties centrales de l'Amerique du Sud . . . Histoire du Voyage,' IV, Chap. LIV, Chap. LV, 1831, he made frequent allusions to animals brought in by Indians at Sarayacu, Nauta, and Pebas. So, even though he nowhere mentioned receiving squirrels of any kind, he had ample opportunity to do so.

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TABLE OF MEASUREMENTS

	Sex	Locality	Head and Body	Tail	Hind Foot	Greatest Length of Skull	Condylar-Incisor Length	Zygomatic Breadth	Nasals (outer edge)	Interorbital Breadth	Breadth Brain Case	Palatal Length	Upper Molar Series (excl. P ₃)	REMARKS
MALES														
Type description of <i>pusillus</i>	ad. ♂	Cayenne	108	76	....	....	....	....	....	....	....	....	....	Measurements transposed from inches and lines of Buffon. (Desmarest wrote "scarcely 3 inches long").
F.M. 21790 <i>p. pusillus</i>	ad. ♂	Fr. Guiana	102	98	24	26.8	24.5	20.2	7.6	11.7	14.7	10.0	3.7	Collector's skin measurements.
F.M. 21788 <i>p. pusillus</i>	ad. ♂	Fr. Guiana	107	98	24	....	....	....	7.1	11.5	13.4	10.6	3.8	Collector's skin measurements.
Type of <i>kuhlai</i>		Pebas	....	....	26	....	....	....	....	....	....	....	....	No measurements of type were published by Gray, although a suggestion of the size was given by Alston (1878). The foot measurement of <i>kuhlai</i> is given by Thomas (1914, p. 575). It does not include the claws. Measured from dry study skin.
A.M. 76185 <i>kuhlai</i>	ad. ♂	Sarayacu	100	80	28	28	25	19.8	7.8	12.2	14.5	10.4	3.7	Measured from dry study skin.
B.M. 14.4.21.1	ad. ♂	Demarara	104	113	27.7	27.5	25	20	7	12.5	15	10	3.8	Hind foot measurements given by Thomas are without claws.
Type of <i>glaucinus</i>														

A.M. 95729 <i>glaucinus</i>	ad. ♂	Tapajoz	98|00|28	27.2	24.9|19.3	6.9|12.6	10.4	.....	External measurements of this specimen and following were taken on fresh specimens by field collector. Feet measured to include claws.
A.M. 95730 <i>glaucinus</i>	ad. ♂	Tapajoz	97 98|28	27.4	25	7.2|12.0	14.8	10	3.7
A.M. 95734 <i>glaucinus</i>	y.ad. ♂	Tapajoz	89|11|27	.....	.....|19	7.5|10.8	.....	10	3.9
A.M. 94746 <i>glaucinus</i>	ad. ♂	Tapajoz	80|14|21	28	25	7.3|11.8	14.5	10.4	4.0
A.M. 94752 <i>glaucinus</i>	y.ad. ♂	Tapajoz	98 00|24	26.9	24.3|18.8	6.8|11.4	13.8	11.0	3.8
FEMALES									
F.M. 21789 <i>p. pusillus</i>	ad. ♀	Fr. Guiana	107 05|25	28.6	25.4|20.1	7.9|12.5	14.6	10.8	4.0
A.M. 94743 <i>glaucinus</i>	ad. ♀	Tapajoz	96 02|29	28	24.6|18.4	7.3|11.4	14.4	11.3	.....
A.M. 94744 <i>glaucinus</i>	ad. ♀	Tapajoz	100 90|27	27.2	24 19	7 11.6	14.2	9.9	3 7
A.M. 94748 <i>glaucinus</i>	ad. ♀	Tapajoz	102 76|27	27.2	24.6|18.9	7.1|11.7	14.8	10.3	.....
A.M. 94751 <i>glaucinus</i>	o.ad. ♀	Tapajoz	102 56|28	28	25.3|19.8	7.7|12.1	14.5	11	3.8
Collector's skin measurements.									
Tail measurement erroneous.									
Tail measurement erroneous.									

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TWO NEW SPECIES OF *GYMNOTUS*

By F. R. LAMONTE

We have recently received from the tropical fish tanks in charge of Mr. C. W. Coates at the New York Aquarium an apparently undescribed *Gymnotus*-like fish. Five others like it are still alive in the tanks. In comparing this fish with American Museum material, I have also come across a new species from Guatemala.



Fig. 1. *Gymnotus coatesi*, from life.
Courtesy New York Aquarium.

Gymnotus coatesi, new species

DESCRIPTION OF TYPE.— Number 12624, American Museum of Natural History; collected 1934, Amazon River, Brazil, by Carl Griem.

Total length, 180 mm.; depth in this length, 11.9; head, 10. Anal rays, 215. Snout in head, 3.7; interorbital, 3; eye, about 15; pectorals, 2.4. Width of head in greatest body depth, 1.6; depth of head, at base of occipital process, in depth of body, 1.8. Anus an orbit in front of vertical from the origin of pectoral. Origin of anal fin on a vertical from a point about 0.9 the head behind the head. Scales large, regularly arranged. Lateral line complete, paralleling the main axis of the body. Teeth conical, fairly large, in three rows in the front of both jaws, and a single row on sides of

mandible. No fontanels; lower jaw much the longer and heavier. Anal fin not quite to end of caudal process. Body cylindrical, dorsal profile almost straight; ventral profile straight to the origin of the anal, then convex, tapering to the tail. Snout blunt.

Color (in life and in preservative): ground color yellowish white, crossed by broad black bands which diminish in width toward the tail. Head from opercle forward entirely black. Fourteen black bands, the last (the tip of tail) and the three preceding it entirely black; the others each with a round white spot on the lower body edge, and the eighth and ninth band with a similar spot on the upper edge also. A circle of white surrounds a round black spot in the center of the side of the first band. In between the bands, running down from the dorsal ridge, are irregular triangles of lightish brown. Fin rays grayish with minute black punctulations on the membrane on either side; the remainder of the membrane white.

As the comparative tables given below demonstrate, this fish is much more slender and cylindrical in shape than *Gymnotus carapo*; the lower jaw protrudes farther beyond the upper; the teeth are in three rows instead of one; the color pattern differs from any phase of *carapo* described, or seen by me. The behavior of the fish in the tank is like that of *carapo*.

Gymnotus cylindricus, new species

DESCRIPTION OF TYPE.—Number 1358, American Museum of Natural History; collected in a brook east of Los Amates, Rio Motagua basin, Guatemala, February 17, 1905, by Newton Miller.¹

Total length, 182 mm.; depth in this length, 9.4; head, 9.4. Anal rays, 250. Snout in head, 3.8; interorbital, 2.8; eye, about 13; pectorals, 2.5. Width of head in greatest body depth, 1.6; depth of head at base of occipital process, in depth of body, 1.4. Anus an orbit in front of vertical from origin of pectoral. Origin of anal fin on a vertical from a point about 0.9 head behind the head. Scales fairly large. Teeth conical, in a single row in each jaw. No fontanels; lower jaw slightly the longer. Anal fin to end of caudal process. Body cylindrical; dorsal profile almost straight; ventral profile convex. Snout flat and blunt.

Color in preservative: yellowish brown, with indications of narrow diagonal crossbars. Head light; fins light, without traces of any markings.

Comparative measurements (in mm.). Specimens of comparable length

	<i>G. carapo</i>	<i>G. coatesi</i>	<i>G. cylindricus</i>
Total length.....	182.....	180.....	187
Greatest body depth.....	24.....	16.....	20
Depth at pectoral.....	16.5.....	10.....	14
Depth 3/4 distance to tail tip.....	15.....	6.....	13
Head width across gills.....	15.....	10.....	13
Head width across eyes.....	12.....	7.....	11

¹Miller, N. 1907, 'The Fishes of the Motagua River, Guatemala,' Bull. Amer. Mus. Nat. Hist., XXIII, p. 103.

	<i>G. carapo</i>	<i>G. xatesi</i>	<i>G. cylindricus</i>
Mouth gape.....	10.....	5.....	9
Interorbital width.....	8.....	6.....	7
Head length.....	25.1.....	17.5.....	20

Comparative measurements (ratios)

Head in length.....	6.9.....	10.....	9.4
Ellis: ¹	7.25-11		
Depth in length.....	7.9.....	11.9.....	9.4
Ellis:.....	8.5-14		
Anal Rays.....	254.....	215.....	250
Snout in head..	3.1.....	3.7.....	3.8
Ellis:.....	2.5-3		
Interorbital in head. .	3.2.....	3	2.8
Ellis:.....	2.25-3		
Eye			
in snout.....	4	4.5.....	3.5
in interorbital.....	6.1.....	5	6
Ellis:.....	4.25-6		
in head.....	12.	about 15.....	about 13
Pectorals in head.....	2.7	2.4	2.5
Width of head in body depth.....	1.8.....	1.6.....	1.6
Depth of head in body depth... ..	1.9.....	1.8....	1.4
Ellis:.....	1.3-1.8		
Teeth....	conical, 1 row..	conical, 3 rows..	conical, 3 rows

¹Ellis, M. M. 1913, 'The gymnotid eels of tropical America.' Mem. Carnegie Mus., VI, No. 3, p. 117.

No. 81, 7 G (66)

A NOTE ON THE CYNODONT, *GLOCHINODONTOIDES*
GRACILIS HAUGHTONBY LIEUWE D. BOONSTRA¹

The type in the Transvaal Museum was originally described by Haughton (Ann. Trans. Mus., XI, p. 85). Although it is not stated, Broom's figures (Mammal-like Reptiles of South Africa, p. 280) of the dorsal and ventral aspects of the skull were based, not on the type, but on a skull (A. M. 2223) now in the American Museum.

This skull is nearly perfect—the lower jaw, the internasal bar and the quadrates being the only parts missing; furthermore, it has not suffered from post-mortem deformation as the type has.

The following account incorporates and supplements the accounts by Haughton and Broom.

In dorsal view (fig. 1)², the main features of interest can be enumerated as follows: the septomaxilla has practically no facial exposure, being a small bone lying nearly wholly within the nostril; the nasals are large and are constricted in their middle portion, but are wide anteriorly and posteriorly; the lacrymal is a fairly large bone with a flat outer surface showing no tubercle or foramen; the prefrontal is of medium size and forms a large part of the supraorbital border; the frontals are small and narrow and do not enter the orbital border; the postorbitals are large elements overlying the edges of the frontals and prefrontals; dorso-medially, they are raised above the frontal surface; their posterior extension along the lateral parietal face is not great; no postfrontal is visible in dorsal view; the parietals are small; the parietal crest is low and triangular in section and it forms the roof of the posterior part of the brain; a small pineal foramen pierces the parietal crest; the squamosal is a large element, extending very far anteriorly along the infratemporal bar, forming the mesial surface of a deep auditory groove and loosely supporting the posterior surface of the quadrates; the jugal forms nearly half of the postorbital bar and has a long posterior limb forming the ventral part of the infratemporal bar.

¹Curator of the Palaeontological Collections, South African Museum, Cape Town²The drawings in this paper are by my wife, Esme E. Boonstra

On the ventral surface (Fig. 2), some interesting features are revealed: the two halves of the secondary palate do not meet in the median line; between the two maxillary plates the ventral keel on the prevomer is visible; the secondary palate is formed by plates from the palatines,

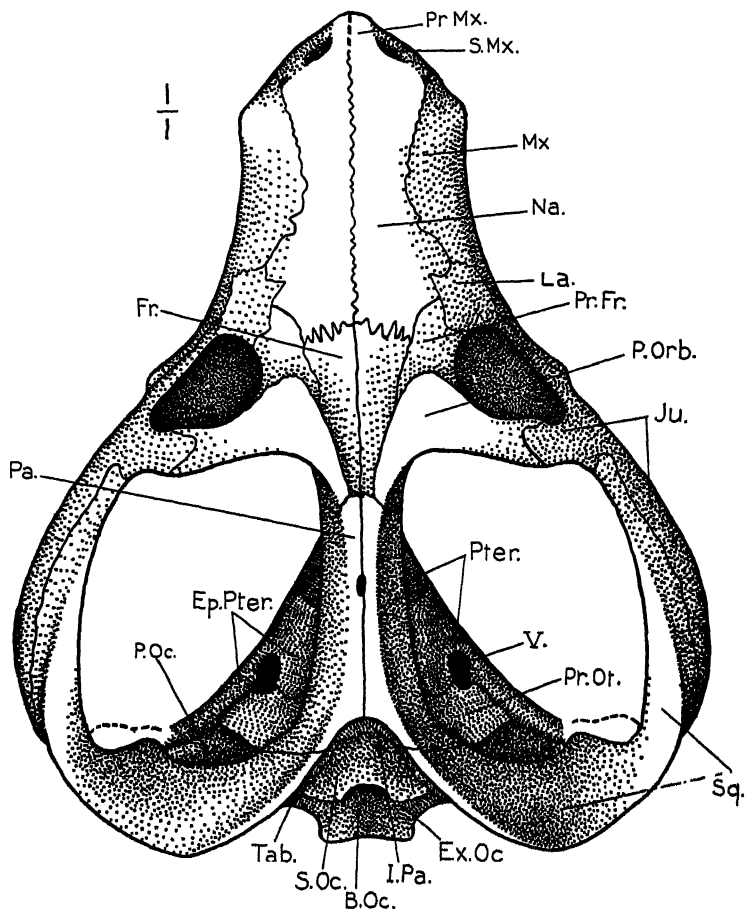


Fig. 1. *Glochinodontooides gracilis*. Dorsal view of the skull. Natural size. A. M. 2223.

The right infratemporal and postorbital bars are drawn from the left side, where they are completely preserved.

maxillaries and partly also from the premaxillaries; the anterior portion of the secondary palate is feebly developed, as here there are only beam-like processes of the premaxillaries between the prevomer and the anterior palatal vacuity; posterior to the palatal process of the right

premaxilla, there lies a small piece of bone which may be part of the premaxilla, but a strip of matrix separates it from the premaxillary process proper; between the two premaxillary processes the widened anterior end of the prevomer is visible; the latter carries a median and a lateral

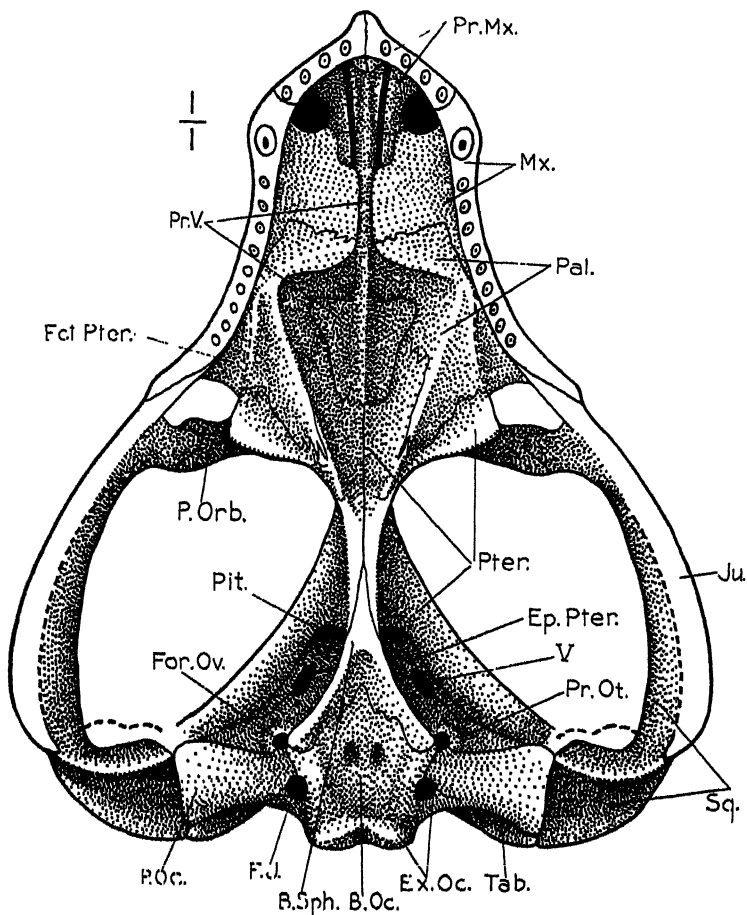


Fig. 2. *Glochinodontoides gracilis*. Ventral view of the skull. Natural size. A. M. 2223. The quadrates are not preserved.

ridge as is typical in the therocephalians and gorgonopsians; the posterior end of the prevomer, which underlies the palatines, is broadly spatulate and carries a ventral keel, which dies out at the posterior end of the bone; the palatines are large and form part of the dorsal roof of the

naso-pharyngeal duct; antero-laterally, the palatine descends to form a ridge, whence it sends a sheet of bone mesially to form part of the floor of the naso-pharyngeal passage; the lateral border of the palatine forms a slight ridge, lateral to which lies the ectopterygoid; the pterygoid has a fairly strong quadrate ramus, which does not, however, reach the quadrate; the lateral pterygoid ramus is weak and does not descend so far as in the more primitive therapsids; a ridge between the lateral and anterior pterygoid rami is continued forward on the palatine and served for the attachment of the soft palate; the basioccipital is practically excluded from the condyle, but, antero-ventrally, it has two fairly strong tubera to which the basisphenoid is applied; the basisphenoid has no tubera; anteriorly, it is clasped by the pterygoids; although here described as the

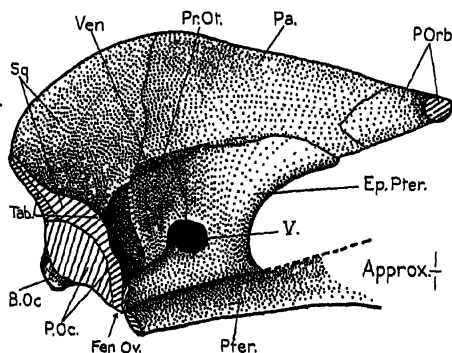


Fig. 3. *Glochinodontoides gracilis*. Lateral view of the posterior part of the right side of the brain-case. Nearly natural size. A. M. 2223.

The occipital plate and the postero-lateral extremities of the epipterygoid are shown in section.

basisphenoid, the bone visible in ventral view may really be a thin parasphenoid closely applied to an overlying basisphenoid; without a cross-section it is not possible to determine whether there are actually two bones; Parrington has described a parasphenoid in *Thrinaxodon*; when I was in Cambridge he very kindly showed me his specimens, and I was able to convince myself that in this genus at least, there is evidence of a thin shell of bone closely applied to the basisphenoid; it thus appears reasonable to assume the presence of a parasphenoid in all the cynodonts, but it would be valuable to have a series of cross-sections to confirm this assumption; the paroccipital is of medium size; laterally it abuts against the squamosal, where this bone forms the mesial surface of the auditory groove, and, mesially, it meets the basioccipital and exoccipital

and contributes to the formation of the raised border of the foramen ovale; the double condyle is formed by the exoccipitals; the limits of the latter cannot be determined as they are very closely fused to the basioccipital.

The outer surface of the brain-case has been exposed on the right side (fig. 3). The occipital plate is shown in parasagittal section, and the outer surface of the brain-case as projected on the sagittal plane. The epipterygoid is widened, so that, dorsally, it has a long suture with the parietal and, ventrally, has a long base resting on the quadrate ramus of the pterygoid; the bone has a constricted waist, and its posterior edge is notched for the passage of branches of the fifth nerve; postero-laterally, the epipterygoid is prolonged beyond the termination of the quadrate ramus of the pterygoid; the anterior borders of the epipterygoids are situated widely apart (contrast "*Lycaenodon*"). The proötic lies at a greater distance from the median line than is the case in the more primitive gorgonopsians and therocephalians; it lies in the same plane as the epipterygoid, to which it is intimately applied; its dorsal edge meets the parietal and squamosal; its antero-ventral corner is notched for the passage of the two branches of the fifth nerve; a slit between the proötic and the parietal is a remnant of the large venous foramen usually found in therapsids. I have not been able to locate the foramen for the seventh cranial nerve. Postero-lateral to the proötic the small post-temporal fenestra pierces the occipital plate.

SHORT DISCUSSION.—The wide spatulate posterior end of the pre-momers appears to be a feature retained from the therocephalian ancestors. The widened epipterygoid, and the concomitant incorporation of the *cavum epiptericum*, are features whose development is foreshadowed in the primitive therocephalians and actually paralleled in some of the higher therocephalians. The narrow parietal crest and the loss of a distinct postfrontal are also therocephalian features. No therocephalian, however, has such a developed secondary palate; the approximation of the alveolar borders in the whaitsids is not homologous. In the bauriamorphs the development of the secondary palate has proceeded much further, but on a different path. In *Bauria* the false palate is formed by the premaxillaries and maxillaries, whereas in the cynodonts the premaxillary part is incomplete and the posterior part is formed by the palatine. If *Bauria* and the cynodonts are both derived from the therocephalians, then it is manifest that they diverged very early in their phylogenetic history.

Chief Measurements of the Skull

Premaxilla to basioccipital.....	106 mm.
Premaxilla to pineal foramen.....	76 mm.
Premaxilla to front of orbit... ..	44 mm.
Interorbital width.....	23 mm.
Intertemporal width.....	11 mm.
Width across the squamosals. ...	90 mm.
Length of molar series (8 teeth).....	22 mm.

59 57, 99 M (67 5)

BEES OF THE GENUS *MEGACHILE* FROM THE BELGIAN
(CONGO)

By T. D. A. COCKERELL

Except when the contrary is stated, all the bees recorded below were obtained by Messrs. Lang and Chapin on the American Museum Congo Expedition, and will be found in the collection of the American Museum.

Frequent reference has necessarily been made to a larger paper on African *Megachile*, not published at the time of writing. It will presumably appear in 1935.

***Megachile adeloptera* Schletterer**

This was described in 1891 from females taken in the lower Congo district. Some of the salient characters are black hair of face and front (instead of the clear white of *M. xanthoptera* Smith), the mandibles with two conspicuous apical teeth, the dense sculpture of the mesothorax, the white hair at sides of abdomen, the black ventral scopa which is pallid at base. The species has not been well understood, and in the Congo Museum I found more than one species standing under this name. But I am now satisfied that the true *M. adeloptera* is the species that I described (1931) as *M. lineolata*, and Vachal (1903) called *M. duponti*. The following specimens belong here: Stanleyville, 14 ♀, March, April; Thysville, 1 ♀, June; Gamangui, 1 ♀, February.

The male *M. adeloptera* as described by Friese is a *Creightonella*, and in 1931 (Rev. Zool. Bot. Afr., XX) I discussed this species as a member of that subgenus. But apparently this is not the case; the true male is a typical *Eumegachile*, with the clypeus exposed, and carrying a long white beard on lower part. Now Vachal describes such a male for his *M. duponti*, and especially remarks on the large blood-red longitudinal band on the mandibles, and the inner mandibular ridge going more than halfway toward base. A male agreeing with his description comes from Stanleyville, March, 1915, and it may be added that the mesothorax is distinctly transversely lineolate. The coxae are well spined; and the red anterior basitarsi, though only moderately broad,

are hollowed beneath. The front tibiae are red apically. I assume that this is the true male of *M. adelopectera*; it is certainly Vachal's male *M. duponti*. I find a similar blood-red mark on the mandibles of *Gronoceras holorhodura* Cockerell, which is not related.

***Megachile ancillula* Vachal**

Stanleyville, 10 ♀, 16 ♂, February, March, April, one captured by *Bembex*; Faradje, 17 ♀, March, April, October, November, December; 1 Kinshasa, 1 ♂, May; Malela, 2 ♀, July; Garamba, 1 ♀, July; Medje, 1 ♀, May; Thysville, 1 ♀, June. Also the following from the Congo Museum: Elisabethville, ♀ (Dr. M. Bequaert); Lubero, Ituri (M^{me}. Van Riel); Luluabourg (Callewaert); Leverville (M^{me}. J. Tinant); Kilo (G. du Soleil); Katombe, Lomami (Dr. M. Bequaert); Kalwe, Lomami (Quarré); Moto, Haut Uélé (Burgeon); Abemba, Haut Uélé (Burgeon); Congo da Lemba (Mayné).

***Megachile atriceps* Cresson**

Stanleyville, 3 ♀, April; Poko, 1 ♀, August; Niangara, 1 ♀, November. This is a species of *Eumegachile*, described from Cuba, but introduced from Africa.

***Megachile bituberculata* Ritschert¹**

Stanleyville, both sexes, April; Gamangui, ♀, February; Thysville, ♀, June; Niangara, ♀, November; Malela, both sexes, July; Poko, both sexes, August; Boma, ♂, June. Natal: Durban, 2 ♂ (4969).

A very abundant species in the Congo basin. The male has red hair on the sixth tergite. One Durban male represents the variety *mediocana* Cockerell, having the hair at end of thorax and base of abdomen pure white, but the other has this hair slightly yellowish. The name *mediocana* is hardly worth recognizing. A female of the variety *rubripedana* Strand was taken by A. Collart at Blukwa, Ituri, November 22.

***Megachile callichlora* Cockerell**

Stanleyville, 1 ♂, April. The Congo Museum sends it from Kapwasa, Katanga, ♀ (Brédo); Fala, ♂, ♀ (Brédo); Kisantu, ♂, ♀ (Vandercryst); Luluabourg, ♂, ♀ (Callewaert); Stanleyville, ♂ (Dr. Bequaert); Kadiamapanga, Katanga (Brédo).

¹Mixed with these, and superficially resembling them, I found *Lathrugus sparganotes* Schletterer, from Stanleyville and Ava Kubi. There is also a male of this species from Batwasende, September, 1909.

Megachile claribasis Cockerell

(Samangui (27° 30' E., 2° 10' N.), 1 ♀, February, 1910. It seems probable that this species is conspecific with *M. bouyssoui* Vachal, 1903. Meade-Waldo examined male types or cotypes of this and *M. deversa* Vachal, both from Chutes de Samlia, and found them apparently the same. He did not see the females, and the holotype of *M. bouyssoui* must be considered to be the female from N'Doro, which differs from *M. deversa* by the shining mesothorax. It now seems probable that the supposed male *M. bouyssoui* examined by Meade-Waldo do not belong to that species; that is, Vachal had two species under the name, but the name must now be restricted to the female.

Megachile crocuta Schletterer

Stanleyville, 6 ♀, April; Thysville, 1 ♀, June; Poko, 3 ♀, August. These females are *M. crocutella* Cockerell, which I now consider to be inseparable from *M. crocuta*. There are twelve males of *M. crocuta* from Stanleyville, March, April. The Congo Museum sends this species from Eala (Brédo); Komi, Sankuru (Ghesquière); and Modu (N'Asnla), June 5 (Brédo).

Megachile decemsignata Radoszkowski

Stanleyville, 1 ♂, April 2. This is like *M. crocuta* Schletterer in almost all respects, but the thorax anteriorly has pale red hair, especially noticeable in front of the tegulae; there is also reddish hair along the sides, above the wings. The sixth tergite is very short, less produced than in *M. crocuta*. This I take to be the male of *M. decemsignata*, which was based on a female from Angola. According to Friese, *M. decemsignata* and *M. crocuta* are one species, but the matter is not settled, and it is better to regard them provisionally as distinct.

Megachile ealana Cockerell

Stanleyville, 1 ♀, April 17, 1915. This was described from Eala, Belgian Congo, where it was collected by R. LeJeune in 1929. It looks exactly like *M. clypearis* Friese and *M. trichora* Vachal. From the latter it is easily known by not having the peculiar hairs on the legs, and by the mandibles, which are very broad, with two apical teeth, and then a long cutting edge, with only a slight rudiment of the third tooth. From *M. clypearis* it is especially known by the low broad clypeus, of *Eumegachile* style, with a shining raised line in the middle. The mandibles also differ conspicuously, and the hind basitarsi are broader.

Thus we have two species which, on the clypeus and mandibles, would be classified in different subgenera, but which are in other respects extremely similar. Also from Stanleyville are five males of *Eumegachile* type, and these agree with what I have described (1931, Rev. Zool. Bot. Afr., XX, p. 145) as the male of *M. clypearis*, though expressing doubt. I now conclude that this insect is the male of *M. calana*. My female *M. clypearis*, as recorded in the same place, is correctly named. There is also a male *M. calana* from Thysville, June.

***Megachile ekuivella* Cockerell**

Vankerekhovenville, 29° 30' E., 3° 20' N., 1 ♀. This is in the Kibali Ituri District.

***Megachile flavibasis* Cockerell**

Natal: Durban, 1917 (4969). Compared with the type.

***Megachile flavida* Friese**

Boma, one ♀, June 17, 1915. Resembles *M. lobicauda* Cockerell, but the ventral scopa is light red instead of white, and the hair of face is white.

A male from Banana, April, 1915, is peculiar for having the hair of face rich golden (but the triangular patch on base of mandibles white) and the transverse keel of sixth tergite broadly rounded, neither emarginate nor dentate. The greatly widened front basitarsi are creamy white, having at the apex an enormous black lobe, so that it may be said that the basal half appears white, the apical half black.

M. flavida is generally known as a species occurring from Katanga to Natal, and it is surprising to find it at the mouth of the Congo.

***Megachile gratiosa* Gerstaecker**

Stanleyville, 7 ♂, April; Faradje, 1 ♂, March.

The males of *M. ancillula* and *gratiosa* are small and superficially much alike. They are easily separated thus:

Tergite 5 with a white marginal hair-band; front femora light red above; front tibiae red on inner side.....	<i>ancillula</i> Vachal.
Tergite 5 with no white marginal band; front femora dark above.	

gratiosa Gerstaecker.

M. gratiosa is very widespread; Kohl records it from Aden (Arabia); it has been taken at Port Said, Egypt, and at Port Sudan, Sudan, by J. Ogilvie, and in South Africa.

Megachile guineae Strand

Stanleyville, 3 ♀, April. It is smaller than *M. callichlora* Cockerell and does not have the dense white hair on cheeks. It is closely allied to *M. bangana* Cockerell, from Liberia, but has not nearly so much black hair on abdomen. The mandibles are quadridentate, suggesting *M. decemsignata* Radoszkowski, but the black hair on thorax above excludes it from that. The clypeus is not keeled. I considered whether this might be the female of *M. pugionifera* Cockerell, but it appears too small, and there is no definite reason for associating these species together.

Megachile langi, new species

MALE. Length about 11 mm., front wing 8.5; black, rather slender, with parallel-sided abdomen; mandibles and the very long slender simple antennae black; eyes dark purplish; face broad; mandibles bidentate, not evidently hairy at base, and with no tooth below; clypeus ordinary, very densely punctured, but glistening between punctures, with no keel or smooth line, the disc, as well as the sides of face adjacent, covered with very long black hair, but the region between antennae with long pale yellowish hair, contrasting; vertex and sides of front with black hair, under side of head with very long pale yellowish hair; upper part of cheeks thinly hairy; mesothorax and scutellum excessively densely and minutely punctured, faintly glistening; lower end of metathorax with a pair of large shining pits; mesothorax with intensely black hair, but scutellum and hind part of thorax with cream-colored hair, as well as a band at sides above the wings, and the anterior margin of thorax, the same hair also covering sides of thorax; tegulae small, very dark brown; wings dilute fuliginous, more or less violaceous; basal nervure falling short of nervulus; second cubital cell long, receiving recurrent nervures about equally far from base and apex; front coxae with well-developed, not very long, parallel spines; legs black, with thin hair, partly black and partly pale; front tarsi simple, rufous apically, the basitarsi with a long black fringe, the other joints with a pale fulvous fringe; middle tarsi with a grayish fringe, and long black hairs from basitarsi; hind basitarsi slender, seen from without showing a red fringe behind; first tergite with long creamy white hair; second tergite with pale hair at base, and at sides of the otherwise red marginal band; remaining tergites with very bright red hair, thin, and mainly abraded on 3 to 5, but dense and long on 6, and all the tergites except the first with broad red marginal hair-bands; transverse keel of tergite 6 with a deep semicircular emargination, but no denticles; apex of venter broadly rounded, reddened at end; no ventral hair-bands.

Stanleyville, 1 male, April, 1915. There is a superficial resemblance to *M. nasalis* Smith, but that differs in various characters, as for instance the hair of the face. From *M. ferrihirta* Cockerell it is separated thus:

Wings orange with dusky margin; sides of face with much white hair; first tergite above with red hair. *ferrihirta* Cockerell.
Wings dilute fuliginous; sides of face with black or grayish-black hair; first tergite above with white hair. *langi* Cockerell.

Megachile lobicauda Cockerell

Stanleyville, 1 ♀, 5 ♂, April; Kwamouth, 2 ♀, 1 ♂, May; Kinshasa, 1 ♀, 1 ♂, June; Niangara, 1 ♀, November; Thysville, 2 ♂, June; Poko, 1 ♂, August. The Poko male is very small, only about 9 mm. long, and one from Stanleyville is no larger.

It now appears probable that the *M. nigripoller* Vachal is only a variety of this species, and in that case Vachal's name has long priority. The front basitarsus of the male is white with a black or dusky mark and has at the side a large black lobe. The female has the ventral scopa white or creamy white, black at apex.

Megachile lutescens Cockerell

The males before me differ in respect to the long outstanding hairs of fifth tergite.

- (A.) Outstanding hair of fifth tergite black. (Typical *lutescens*.) Stanleyville, five, April. Also one from the Congo Museum: Nord Tshisangwe, Elisabethville, February (Dr. M. Bequaert). The type locality is Lubutú, about 130 miles from Stanleyville.
- (B.) Outstanding hairs of fifth tergite pallid or red. (Agrees with male assigned to *M. flavibasis* Cockerell, 1920.) Stanleyville, six, April; Thysville, one, June. Also one from Congo Museum: Lukenie River, Sankuru, January (Ghesquière).

When describing *M. lutescens* (1931) I wrote of the male: "It is certainly very near to *M. flavibasis* Cockerell, and perhaps only a subspecies, but readily separated by the black instead of light red outstanding hairs on fifth tergite." *M. flavibasis* was described from Natal, and I find the male identical with the second variety of *M. lutescens* recorded above. The only appreciable difference is in the darkened front legs of the whole series, in both varieties black or suffusedly reddened, much darker than in the original specimens of both species. So far, it would seem a simple matter to use the prior name *M. flavibasis* for the whole series, and call the first variety var. *lutescens*. But the type of *M. flavibasis* was a female, and this differs as follows from what I have determined as female *M. lutescens*, from Umtali, Southern Rhodesia (A. Mackie).

Legs black; mandibles black, faintly reddish subapically; dorsum of thorax with pale fulvescent hair; tergites 2 to 5 with pale fulvescent hair-bands; ventral scopa white at base, entirely red on sternites 3 to 5. *lutescens* Cockerell.

Front trochanters and femora broadly red above, middle femora with a red stripe above; mandibles dark red; dorsum of thorax with much long black hair; tergites 2 to 5 with linear dull white hair-bands; ventral scopa broadly white at sides, nowhere distinctly red *flavibasis* Cockerell.

These females are not the same species, and it now seems highly probable that one or the other has been associated with the wrong male. Thus it seems best for the present to use the name *M. lutescens* for the material recorded above, that name having been based on the male.

I do not find the Umtali *M. lutescens* female in the Belgian Congo collections. *M. semivenusta* Cockerell, found in Katanga, has the ventral scopa white at sides, but it is not at all the same as the Natal female *M. flavibasis*. [*M. semivenusta* has a wide distribution, from Eala (Brédo) to Elisabethville (Ch. Seydel).] *M. polychroma* Cockerell, except for the much smaller size, is exceedingly close to the Natal female *M. flavibasis*.

Another series of ten males can be separated from typical *M. lutescens* as follows:

- 1.—Front femora clear red above; scutellum with cream-colored hair not mixed with black; first tergite with pale bright fulvous hair (Elisabethville).

lutescens Cockerell.

First tergite with white or creamy-white hair; scutellum with much black hair; out-standing hairs on fifth tergite black 2.

- 2.—Front femora red above (Stanleyville, six, April) *lutescens* variety *a*.

Front femora black or very dark above (Stanleyville, three, April; Gamangui, one, February) *lutescens* variety *b*.¹

My present opinion is that these are all varieties or races of one species.

***Megachile marginipennis* Cockerell**

The type is from Bokani, Northern Nigeria (Simpson), and is in the British Museum. It also comes from Yapi, Gold Coast. Lang and Chapin took a female at Faradje, December, 1912. The female is 14.5 to 16.5 mm. long; the dilute orange wings have a broad dark border; legs bright ferruginous; ventral scopa black, the anterior part light red in middle. The female has the scape red and the mandibles black, whereas the male has the scape black and the mandibles red. It may be known from *M. bambiliensis* Cockerell by the dark margin of wings not invading the cells and front coxae of male not spined. The female clypeus is not keeled, except slightly so at apex; the lower margin is gently

¹*M. lutescens* variety *b* from Stanleyville, which we now notice has longer and darker wings, is found by Miss Edith Stice to have quite distinct genitalia, and must be considered a distinct species. The variety *a* and the forms noted under (A) and (B) have the genitalia alike. The holotype of *M. lutescens* has the legs black. The variety *b* may be called *Megachile sticcede*, new species.

concave. The first tergite is covered with pale or bright red hair, whereas the second and third have reddish bands.

***Megachile obtusodentata* Friese**

Stanleyville, 7 ♀, April; Thysville, 2 ♀, June; Zambi, 1 ♀, June. When in good condition, this is easily recognized by the pale hair-bands at sides of tergites, but it is exceedingly close to *M. bituberculata* Ritsema. The female clypeus is deeply incised at apical middle, and the axillae are shining. A female from Thysville is smaller than usual, only about 11.5 mm. long. I have described the male of *M. obtusodentata*, in a paper not published at the time of writing, from a specimen collected by S. A. R. Prince Léopold (now King of the Belgians) at Ilebo, Kasai District. I find three males collected by Lang and Chapin at Stanleyville, April, 1915.

***Megachile phanerognatha*, new species**

FEMALE.—Length about 10.5 mm., anterior wing 7.7; black, robust, with heart-shaped abdomen; hair of head and thorax rufo-fulvous, long and dull white on cheeks below, but on upper part of cheeks thin and slightly fulvescent, long and very dark brown on vertex, but tuft before ocelli fulvous; dull whitish on under side of thorax, but fulvous on tubercles and below wings; no admixture of dark hairs on thorax above; mandibles broad, quadridentate counting inner corner, a reddish depressed band back of teeth; base of mandibles broad, dull, with only very thin inconspicuous hair; clypeus convex, simple, strongly punctured, the upper middle shining between punctures, but no keel or smooth line; supraclypeal area closely punctured, but shining in middle; vertex dull; antennae black; mesothorax and scutellum entirely dull, conspicuously hairy; tegulae very dark brown; wings dusky; basal nervure falling a trifle short of nervulus; second cubital cell long, receiving second recurrent nervure much nearer apex than first to base; legs black, with pale fulvescent hair, red on inner side of tarsi; hind basitarsi greatly broadened; tergites 1 to 5 covered with short red hair, the paler marginal bands slender and inconspicuous; sixth tergite with thin grayish tomentum, and scattered, not very conspicuous, long black hair; ventral scopa pale yellow at base, then bright red, black on last sternite.

Stanleyville, 1 female, April 24, 1915. Much resembles *M. hypopyrrha* Cockerell, but differs by the fulvous (instead of black) hair in front of ocelli, the lack of dense white hair on cheeks, and the orange (not white) band on margin of fifth tergite. Resembles *M. corneipalmis* Vachal, but lacks the abundant long coarse black hair on sixth tergite, and hair at sides of face is fulvous (white in *M. corneipalmis*). The following key to females will also be useful.

1.—Tegument of base of abdomen red.

corneipalmis Vachal and *mellisferina* Cockerell.

Tegument of base of abdomen black. 2.

2. -Cheeks not covered with white hair. *phanerognatha* Cockerell.
Cheeks densely covered with pure white hair. 3.
3. -Mandibles very broad at base and covered with long hair. *pogonognatha* Cockerell.
Mandibles not thus broad and hairy. 4.
4. Tegulae dark brown; fringe of fifth tergite white, contrasting with that of
fourth *hypopyrrha* Cockerell.
Tegulae light fulvous; fringe of fifth tergite like that of fourth. *cordata* Smith.

Megachile pogonognatha, new species

FEMALE. Length slightly over 10 mm.; black, with the general build and appearance of *M. ekuivella* Cockerell, but with more massive mandibles, and hair of face fulvous. Eyes pale gray, blackish in front; mandibles large, the broad base covered with long yellowish-white hair, in the manner of the much larger *M. planatipes* Cockerell; apical part of mandibles dark reddish, but the border broadly black, the apex with a stout tooth, separated by a broad angular incision from the second tooth, which is merely the corner of the long straight cutting edge which follows; hair of face and front pale yellowish, the color strongest below; clypeus exposed in middle, but sides covered by dense brushes of yellow hair; clypeus finely punctured, with no keel or smooth line, but supra-clypeal area shining; vertex dull and densely punctured, shining at sides when seen from above; hair of vertex short and scanty, pale yellowish, with no black; mesothorax and scutellum entirely dull, with thin short fulvous hair, not mixed with black; thorax posteriorly and at sides with long fulvous hair, becoming dull whitish beneath; cheeks densely covered with long white hair; tegulae small, very dark brown; wings dusky, stigma dusky red; basal nervure almost meeting nervulus; second cubital cell very long, receiving second recurrent nervure near end, the first more remote from base; legs black, with thin grayish and yellowish hair, light red on inner side of tarsi; front legs slightly reddened; spurs red; hind basitarsi about as broad as tibiae, very hairy; abdomen heart-shaped, hind margins of tergites reddish; tergites with broad red hair-bands, and red hair in sulcus of second; sixth tergite with fine dull white tomentum, and no conspicuous black hairs; ventral scopa white at extreme base, but mainly light yellow, black on last sternite.

Kwamouth, 1 female, May 24, 1915. The description of *M. abon-gana* Strand indicates a very similar insect, but that has quadridentate mandibles. Kwamouth is on the Congo, about 3° S. and 16° E.

Megachile polychroma Cockerell

Described in a paper not published at the time of writing, from a female collected at Elisabethville (W. P. Cockerell). Tang and Chapin found females at Bafwabaca, 27° 30' E., 2° 10' N., January, 1910 (three); Stanleyville, April (three).

This species is about 8.5 mm. long and is extremely like the European *M. rotundata* (Fabricius), with the same outstanding black hair at sides of abdomen, as seen from above. The following table will facilitate identification.

- 1.—A white hair-band in scutello-mesothoracic suture; fifth sternite with white hair.
submucida Alfken.
 No white hair-band in scutello-mesothoracic suture. 2.
 2.—Clypeal margin straight; hair of metathorax pure white; apical part of fifth
 sternite with much black hair. *rotundata* (Fabricius).
 Clypeal margin in middle evidently arched and thickened; hair of metathorax
 flavescent; apical part of fifth sternite with little black hair.
polychroma Cockerell.

I do not find *M. polychroma* in the collection received from the Congo Museum. The mandibular teeth in this species are variably multiplied by subdivision. In one Stanleyville specimen, not otherwise peculiar, there are six little equal teeth on the mandibular margin. *M. polychroma* seems too small to be the female of *M. lutescens* Cockerell and is quite unlike what I have supposed to be the female of that species; but it is very close to the larger female *M. flavibasis* from Natal, the male assigned to which appears to be conspecific with *M. lutescens*.

***Megachile pugionifera*, new species**

MALE.—Length about 11.5 mm., anterior wing 8.7; in all respects very close to *M. pugionis* Cockerell, but distinctly smaller, and also differing thus: upper part of clypeus with thin fulvescent hair, but sides of face, supraclypeal region, and front, all with long black hair; thorax anteriorly with black hair, and hair in region of scutellum mainly black; tegulae entirely black; second recurrent nervure meeting outer intercubitus; tarsi with red hair on inner side; spine of seventh tergite with an angular crest at base above (posteriorly). The mandibles have two prominent teeth, the first long, the second triangular; on the front coxae, laterad of the spines, is a large patch of copper-red hair. This hair on the front coxae, and the abdominal spine, indicate affinity with *M. gastracantha* Cockerell, described from Liberia, but also found by Neave, 150–200 miles west of Kambove, in Katanga. The red hair and orange wings of *M. gastracantha* give it a wholly different appearance.

Stanleyville (type locality), March, 1915, one male. A second male, from Ava Kubi, November 17, 1909, is referred here, agreeing in size and the character of the spine, but it has pale hair between antennae, and the second recurrent nervure does not meet the outer intercubitus. The dorsal hair of thorax is denuded.

M. pugionifera is related to the Palaearctic *M. sericans* Fonscolombe, undoubtedly falling in the same group.

***Megachile pugionis*, new species**

MALE.—Length about 12.5 mm., but hard to measure because the abdomen curves downward and inward, as in various osmiines; anterior wing 9.3 mm.; black, with comparatively long and narrow abdomen, its width about 4 mm.; eyes dark brown, slightly purplish; face broad; mandibles and the long simple antennae black; mandibles with a very large tooth, obliquely directed mesad, near the middle beneath;

clypeus convex, glistening, strongly and closely punctured, with no smooth line; the upper part bare, with scattered long black hairs, the lower part with a long dense yellowish beard; sides of face, and region between and below antennae, with very long hair, partly pale yellow, partly black; vertex and front with black hair, cheeks with dull white; vertex minutely and densely punctate-striate; mesothorax and scutellum entirely dull, the punctures excessively small and dense; hair of thorax dull white, long, a little flavescens, but clear white on metathorax, rather short and all black on disc of mesothorax (but white on thorax anteriorly), and black hairs intermixed on scutellum; area of metathorax entirely dull; tegulae very dark brown; wings dark fuliginous, with hyaline base; basal nervure falling short of nervulus; second cubital cell receiving first recurrent nervure nearly twice as far from base as second from apex; legs black, with large claws, but the front femora and tibiae suffused with rufescent in front; hair of legs thin and mostly whitish, not brightly colored on inner side of tarsi; front coxae with short spines, in the midst of long hair; front tarsi simple, with a fringe of dark hair behind; sides of first tergite densely covered with white hair; second with similar white hair, forming a sort of thick L; third to sixth with transversely elongate white marks at sides, but no bands across the middle; sixth convex, with short black hair, with no median keel, concave before the broadly rounded transverse keel, which is neither emarginate nor dentate; seventh tergite produced into a very long spine, the upper (posterior) margin of which is straight. There are no pulvilli, but there is a little tuft of hair between the claws.

Poko, August, 1913, 1 male. A peculiar species, with the spine near apex of abdomen beneath suggesting the otherwise quite different *M. nigriceps* Friese. The spined seventh tergite allies the insect with *Creightonella*, but the sixth tergite is wholly different.

***Megachile pyrrhorthorax* Schletterer**

MALE. —Length about 12 mm., anterior wing 9; robust, with short abdomen; black, including mandibles and antennae; tegulae nearly black, the margin reddened anteriorly; middle and hind legs black, but front legs clear red, the femora with a dusky suffusion at end, the tibiae with a broad black stripe behind; head, thorax and first tergite with abundant long fulvous pubescence, on vertex, mesothorax and tubercles ferruginous, on hind part of thorax and first tergite pale; antennae evidently but not greatly broadened at apex; mandibles tridentate, the second tooth long and curved, a great tooth near base beneath; upper part of clypeus bare, highly polished, impunctate; vertex, mesothorax and scutellum dull; wings dilute brownish, with dark nervures; basal nervure falling short of nervulus; second cubital cell long, receiving recurrent nervures about equally distant from base and apex; front coxae polished, with stout but rather short spines; front tarsi greatly broadened, the basitarsus with a very broad hollowed lobe, the posterior fringe very long, dense, creamy white; the front tibiae are swollen, and keeled behind, and have strong punctures; middle tarsi dark but broadened, with an extremely long pale red fringe behind; hind tarsi stout, with a long shining pale yellowish fringe in front; abdomen beyond the first tergite entirely black, with black hair, but no bands or spots; transverse keel of sixth tergite broadly bilobed, not dentate; seventh tergite (beneath) with a spine; venter with bands of pale hair.

Stanleyville, April, 1915, 1 male, 1 female. Very near to *M. ruficauda* Cockerell, except for the black abdomen, which gives it an entirely different appearance. Schletterer (1891) described the female. Vachal was of the opinion that this is identical with *M. unifasciata* Radoszkowski (1881), described from Angola. This cannot be definitely affirmed but I now think it probable.

***Megachile rhodesica ituriana*, new subspecies**

FEMALE.—Length about 10 mm., anterior wing a little over 6; black, the head and thorax with dull white hair, but long thin blackish hair on vertex, but no dark hair on thorax above, the hair on mesothorax extremely thin and short; mandibles black, a little reddened near apex, the base with a small patch of pale, slightly flavescent, hair, the outer side strongly sulcate, the cutting edge very oblique, quadridentate; clypeus exposed in middle, overlapped at sides with yellowish-white hair, the disc convex, very densely and minutely punctured, glistening in middle, with a fine smooth line, visible only from a certain angle; margin of clypeus straight, not thickened; lower margin of supra-clypeal area shining; vertex behind ocelli very short, dull; cheeks with white hair; flagellum bright ferruginous beneath, dusky at base; mesothorax and scutellum entirely dull, excessively finely and minutely punctured; no trace of a light band in scutello-mesothoracic suture, but a slender band along hind edge of scutellum; area of metathorax dull; tegulae very dark reddish brown, with a broad hyaline margin; wings dusky hyaline; second cubital cell long, receiving second recurrent nervure near apex, the first more distant from base; legs reddish black, with the usual pale hair, reddish on inner side of tarsi; hind basitarsi broad, very hairy, about as long as the other joints together, fifth joint clear red; abdomen dull, minutely punctured; first tergite with white hair at sides; tergites with very slender, slightly flavescent bands, largely failing or denuded in middle, but not broadened at sides; sixth tergite with a transverse patch of grayish tomentum, not conspicuous; ventral scopa pure white at base, light red on sternites four and five (not black at sides), on sixth red at base, otherwise black.

Faradje, December, 1912, 1 female. Resembles *M. venusta* Smith, but distinguished by various characters, especially the red under side of flagellum. The color of the flagellum also distinguishes it from *M. rhodesica* Cockerell, but it is so similar that I treat it as a subspecies. I had come to regard *M. rhodesica* as a race of *M. venusta*, but the genitalia of a male from the Matopo Hills, Southern Rhodesia, presumed to belong to *M. rhodesica*, show structures very distinct from those of *M. venusta*.

***Megachile rhodotrichura* Cockerell**

Stanleyville, 1 ♂, April. Looks like *M. torrida*, but hair on fifth tergite is bright red instead of black. Described from Katanga.

Megachile rudissima Cockerell

The female looks exactly like *M. adeloptera* Schletterer, but is really quite distinct. The dull densely punctured mesothorax is without the glistening transverse striae; the mandibles have the third tooth well developed, and there is a conspicuous line of pale hair just back of the margin; the femora have peculiar, evenly spaced, capitate hairs. This species has been considered very rare, but the following specimens are in the collection.

Stanleyville, 15 ♀, February, March, April; Thysville, 1 ♀, June; Gamangui, 2 ♀, February; Poko, 1 ♀, August.

Males which I refer here are of the *Eumegachile* type, the broad mandibles entirely black, with the carinae lacking on the broad dull basal portion. There are seven from Stanleyville, March and April, and two from Gamangui, February. This male agrees rather closely with Vachal's account of male *M. deverea* Vachal, but the type of *M. deverea* is a female from N'Doro, differing in many respects from *M. rudissima*. Male *M. rudissima* has the front coxae with short spines; tibiae rufous apically and the red front basitarsi hollowed beneath, as in *M. adeloptera*; face very broad; clypeus densely punctured, not keeled (in *M. adeloptera* there is a raised line on upper part); antennae entirely black; tegulae black; wings fuliginous except at base; mesothorax and scutellum dull and very densely punctured; white spots at sides of abdomen transverse and well separated; apex with much black hair, the transverse keel of sixth tergite very broadly rounded and shallowly emarginate.

Megachile ruficauda Cockerell

Stanleyville, March and April, 2 ♂.

Megachile rufipes (Fabricius)

Taken in great numbers at Faradje, Stanleyville, and Poko. All the Faradje and Poko specimens are females, and there are only six males from Stanleyville, taken in April and August. There are many males from Boma, taken in June. From Lisala two males and two females, May. Matadi, June, 4 ♀. Kwamouth, May 24, 1 ♀. Nianguara, November 19, 2 ♀. Thysville, June, 1 ♀.

Megachile simulator Cockerell

Faradje, 3 ♀, December; Yakuluku, 4° 20' S., 28° 50' E., November, 1 ♀.

The type, nearly 18 mm. long, is from Yapi, Gold Coast (Simpson), and is in the British Museum. The female resembles *M. ikuthaënsis*

Friese, which has a similar ventral scopa (very dark brown, black on last sternite), but *M. simulator* differs by the pale hair of legs and gray hair of third tergite. The male (from Yapi) comes close to *M. saganeitana* Gribodo, which also has spines at sides of sixth tergite, but in Gribodo's species tergites 1-5 are densely red-haired, six has gray. The Lang and Chapin females show that the hair of third tergite varies to dark brown, and they show much black hair on legs. Thus it might appear that the species is after all *M. ikuthaënsis*; but it has the short broad clypeus of *Eumegachile*, and Friese does not place his species in that group; Friese also says that the tergites of *M. ikuthaënsis* are shining, finely and sparsely punctured; in *M. simulator* they are dullish, the punctures numerous, running in rows. A noteworthy feature is the pale hair on inner side of hind tibiae, the hind edge of which shows as a pale line when the insect is seen from behind.

One of the specimens carries a large lump of orange resin under the mandibles, indicating that it is a resin worker.

***Megachile torrida* Smith**

Poko, 2 ♂, 1 ♀, August; Banana, both sexes, August; Malela, 2 ♀, July; Faradje, 11 ♀, March, April, and December; Stanleyville, 1 ♀, 1 ♂, April, May; Boma, 1 ♂, June; Vankerekhovenville, 1 ♀, April. This looks like the male of *M. rufipes*, but it is easily separated by the strong keel on clypeus of female and the face of the male covered with light hair.

The male from Boma is unusually small, with narrower face than usual. The legs, typically red, vary in color. One Faradje female and two from Eala (Brédo) have black legs; the other Faradje females have red legs. A female from Chinchoxo has the hind tibiae red, but hind tarsi black, and longer than in the Faradje specimens.

***Megachile trichora* Vachal**

Stanleyville, 3 ♀, 1 ♂, March, April; Gamangui, 1 ♀, February. Superficially resembles *M. clypearis* Friese, but it is longer and more slender. The male is remarkable for the transverse keel of sixth tergite, which is very short, black, wide, broadly truncate, the truncation somewhat concave. The thick but simple front basitarsi have a long fringe behind, which is mainly black, but pale at base. The face is covered with pale fulvescent hair, mixed with brown, and thus the male is at once distinguished from *M. chrysorrhoea* Gerstaecker, in which the upper part of the clypeus is bare, and the lower carries a dense, pure white beard.

Megachile truncaticauda Cockerell

Stanleyville, 9 ♂, April, May; Gamangui, 1 ♂, February; Akonge, 1 ♂, September; Thysville, 1 ♂, June. The mandibles have a large tooth near base beneath; the front coxal spines are strongly divergent; the sixth tergite is covered dorsally with red tomentum.

Megachile venusta malelana, new subspecies

FEMALE.—Length about 8 mm.; at first sight appearing to be *M. ancillula* Vachal, but easily distinguished by the pale (bluish appearing) tomentum covering at least basal half of sixth tergite. Eyes reddish; clypeus with a shining band from base to apex; mandibles black, a little red at tip, with whitish tomentum at base; antennae black, the flagellum very feebly rufescent beneath; hair of face and front cream-color, lighter and abundant at sides of clypeus, of vertex black, of cheeks pure white; mesothorax and scutellum entirely dull; no pale band in scutello-mesothoracic suture; hair of thorax above thin, pale fulvous, not mixed with black (thus quite different from *M. ancillula*); hair of tubercles yellowish, but of mesopleura dull almost bluish white; tegulae dark brown posteriorly but anteriorly (very broadly) and externally hyaline; wings dusky hyaline, second cubital cell receiving second recurrent nervure a short distance from end, and first not so near base; legs with dull white hair, red or reddened on inner side of tarsi, the color bright on hind tarsi; hind basitarsi short and broad, parallel-sided (as in *M. ancillula*, but distinctly broader); ends of tarsi red; abdominal bands slender and entire, pale flavescent; ventral scopa pure white at base, bright red (without black at sides) on sternites 4 and 5, entirely black on sixth.

Malela, 1 female, July 9, 1915. In an unpublished table this runs to *M. asarna* Cockerell, from Ceres, Cape Province (J. Ogilvie). The two are distinguished thus:

Hair of face cream-color; tegulae partly dark; hair of thorax above fulvescent; abdominal bands yellowish; hind basitarsus not as long as the remaining joints together; second cubital cell shorter.....*venusta malelana* Cockerell.
Hair of face pure white; tegulae entirely pale testaceous; hair of thorax above white; abdominal bands white; hind basitarsus about as long as the remaining joints together; second cubital cell longer.....*asarna* Cockerell.

It is smaller than *M. ekuivella* Cockerell, with the abdominal bands considerably narrower and not so red.

On all counts this falls nearest to *M. venusta* Smith, but it is separable (Smith's type examined) by the black hair of sixth sternite (as in *M. ancillula*), and hair at sides of face yellowish. The sides of fifth sternite lack the dark or black hair which appears in *M. meade-waldoi* Brauns, *M. marusa* Cameron, and *M. seychellensis* Cameron. There are two places called Malela; our insect came from the one 6° S., 12° 40' E., near the mouth of the Congo.

***Megachile uvirensis* Cockerell**

Described in a paper not published at the time of writing, from Uvira, Belgian Congo (J. Ogilvie). Lang and Chapin collected two (one lacks the head) at Malela, July. This is almost exactly like *M. polychroma* Cockerell, but when the abdomen is seen from above, white hair projects at sides, and the sixth tergite has no pale tomentum. The hind basitarsi are very broad. Length of insect about 10 mm., anterior wing, 6.5. The mandibles are quadridentate.

Subgenus *CREIGHTONELLA* Cockerell***Megachile elegans* Friese**

Thysville, June 2, 1 ♀. The hair of face and front is slightly fulvescent, not pure white as in a specimen from Uvira (A. Mackie). A characteristic feature is the abrupt enlargement of the white hair-bands at sides of tergites, making large triangular patches. The ventral scopa is red, black at sides.

***Megachile ianthoptera sosia* (Vachal)**

Coquilhatville, May, 1 ♀; Stanleyville, April, 1 ♀, 1 ♂. The female has quadridentate mandibles, but the hind tarsi have black hair, as in typical *M. ianthoptera* Smith. Smith described the mandibles of female *M. ianthoptera* as quadridentate, but Mr. R. B. Benson has examined the type, and finds them quinquedentate, in accordance with the current identification.

***Megachile polyacantha* Cockerell**

Boma, 5 ♂, June. Three have the spines on transverse keel of sixth tergite red, but in the others they are so dark as to be practically black, as in the type from Thysville. I find in the collection a male from Thysville, June, in which the spines are red. Thus the difference in color appears to have no racial significance.



Fig. 1. *Gronoceras bombiformis* (Gerstaecker). Sixth tergite from sketch of type by Dr. H. Bischoff.

***Gronoceras bombiformis* (Gerstaecker)**

Dr. H. Bischoff has very kindly examined the holotype of *G. bombiformis* in the Berlin Museum, and sends a sketch of the caudal end. He also states that the middle of the clypeus is uniformly densely punctured, and the anterior basitarsi are not so broad as in *G. combusta*. From the details he gives, no doubt can remain that *G. wellmani* Cockerell is the genuine *G. bombiformis* (Gerstaecker), the latter name having of course long priority.

FISHES FROM RIO JURUA AND RIO PURUS,
BRAZILIAN AMAZONAS

BY F. R. LAMONTE

The Museum has received from B. A. Krukoff a collection of fishes made during 1934 in the following localities.

Rio Jurua: collected in the vicinity of the mouth of Rio Embira, a tributary of Rio Tarauaca, which, in turn, is a tributary of Rio Jurua (70° 15' W., 7° 30' S.).

Rio Purus: collected in the vicinity of the mouth of Rio Macauhan, a tributary of Rio Yaco, which, in turn, is a tributary of Rio Purus (69° W., 9° 20' S.).

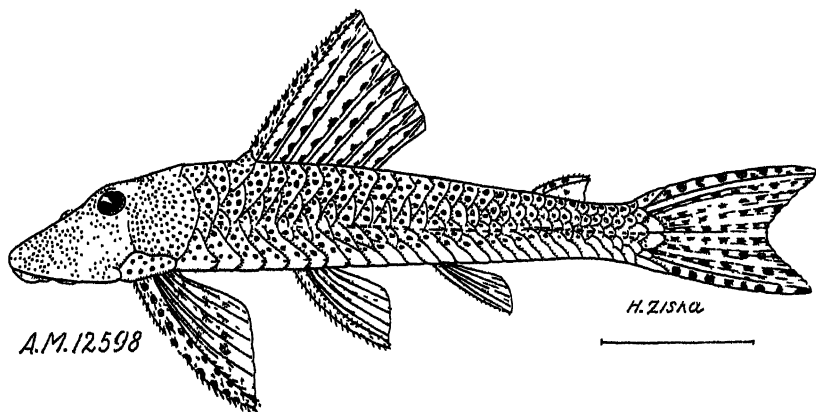


Fig. 1. *Plecostomus micropunctatus*, new species.

***Plecostomus micropunctatus*, new species**

DESCRIPTION OF TYPE. Number 12598, American Museum of Natural History; collected in the Rio Purus, Brazil, 1934, by Boris A. Krukoff.

Length to base of caudal, 108 mm.; depth in this length, 6.5; head, to hind edge of occipital process, 3.4. Eye in head, 6.5 7; interorbital, 2.9; snout, 1.9-2; width of mouth, 3.25; adipose, 3.9; pectoral spine, 1.2; head depth at occiput, 2. Occipital keeled, bordered on its posterior margin by a median and two lateral scutes. Scutes spinulose, not carinate except for a faint indication of keels on either side from the dorsal to the adipose and on the lowest row; 29-30 in longitudinal series, 9 between dorsal and adipose, 11 (+2 on the caudal base) between anal and caudal. Lateral line distinct, 30.

Dorsal I, 7; anal I, 4. Pectoral spine curved and wide, its greatest width very slightly less than eye. All fin spines covered with spinules. Pectorals with teeth all the way to tip on the posterior margin; on the anterior margin large tooth and two small ones alternate all the way to tip. Lower surface of body covered with small very spinulose scutes. Teeth (entire jaw) $\frac{2}{2}$. Barbel slightly longer than or equal to eye. Caudal deeply emarginate, filamentous.

Body elongate, compressed, profile sharply rising to eye, then more gradually to the dorsal origin. Caudal peduncle compressed, its least depth about 3 in its length. Head large, snout narrowly rounded in the type, more pointed in smaller specimens. Interorbital slightly convex, thus making the orbital ridge.

Color in preservative light brown, the ground color of the head and the posterior part of body from the fifth scute behind the pectoral origin lighter. Head thickly covered with very small dark dots except for an unmarked, very spinulose rim from the opercle forward and around the edge of the head to about one-fourth of eye. Dark patch immediately in front of the occipital process. Body spotted, the spots larger than those on the head, about 6 to a scute for four or five scutes, then 3, then, from opposite adipose to the caudal base, 2 or 1. No spots on ventral surface of either the body or the fin spines. There are 10 small distinct black spots on the dorsal spine, and 6 to 8 on all inter-radial membranes, squeezed up close to the next ray. Two rows of spots on pectoral spine; faint spots on ventral spine and rays, and on adipose spine and membrane. Ventrals dark-tipped. The anal seems to have been lightly spotted. Caudal with six or seven rows of spots across it, the spots on the rays, not the membranes. No spots on outer unbranched ray of lower lobe. From the fifteenth scute back of clavicle and below the lateral line to base of caudal, there are no markings visible except faint indications of one row of dots just below the lateral line. All the dots referred to in the color pattern are about one-half the size, or less (on head), of those of *emarginatus* or any of the other dotted *Plecostomus*, except perhaps the type of *madeirae*. I do not believe the color pattern of the spotted species of *Plecostomus* to be diagnostic except possibly in the general size of the spots.

This species is near *P. madeirae* Fowler from the Madeira River, Brazil. The chief differences lie in the lesser head and body depths of ours, its greater mouth width, its shorter adipose spine. In *P. madeirae* the gill opening is bordered with slightly enlarged spinules; ours has none. The lateral line of *madeirae* is "evident as 8 simple, small pores"; in ours it is well defined for the entire body length. The lower caudal lobe is the longer in *madeirae*; the upper, the longer in ours. In *madeirae* the posterior sides of the body are described as immaculate and whitish; ours differs from this as described above. Fowler compares his specimen with *P. cordovae* from the Argentine, a longer and more slender fish. Alipio de Miranda Ribeiro (Rev. Mus. Paulista, 1918, vol. 10, p. 629) describes *P. interruptus* from Rio Juquiá, which seems to be near ours, the description, however, is incomplete, the fish is not figured, and the type is not available to us. *P. tenuicauda* Steindachner is also near, but has fewer scutes, more teeth, and a shorter caudal peduncle.

Type and 4 cotypes
1 specimen

108, 103, 90, 86, 76 mm.
127 mm.

Rio Purus
Rio Jurua

***Hemiancistrus brevis*, new species**

DESCRIPTION OF TYPE. Number 12602, American Museum of Natural History; collected in the Rio Purus, Brazil, 1934, by Boris A. Krukoff. Our only specimen.

Length to base of caudal, 91 mm.; depth in this length, 4; head, 3. Eye in head, 6.7; interorbital, 2.1; snout 1.8. Mandibular ramus in interorbital, 3; eye in interorbital, 3. Width of head in its length, 1.1; its depth, 1.5. Barbel, 0.1 greater than diameter of eye. Teeth, on one ramus, $\frac{13}{8}-\frac{14}{4}$, very sharply hooked. Supra-occipital bordered by a median and one lateral scute. Hooked bristles on opercle. Scutes, 25 in longitudinal series, very spinulose, carinate only on the row either side of

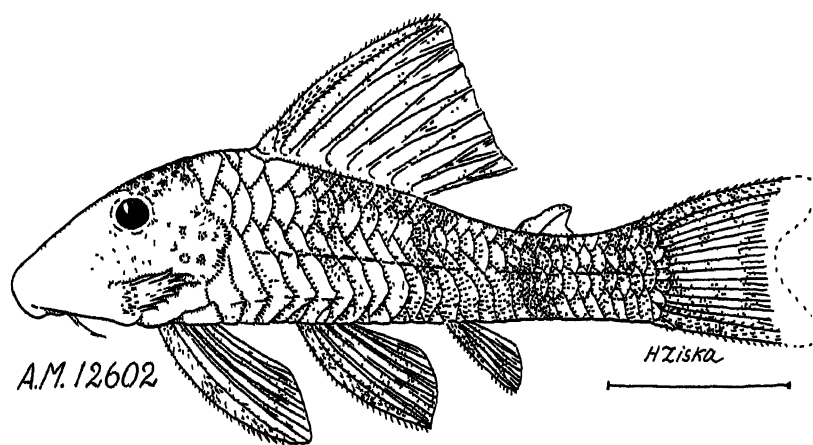


Fig. 2. *Hemiancistrus brevis*, new species.

dorsal to adipose, and the three scutes behind the clavicle. Abdominal surface granular except for naked strip across and above ventrals. Caudal broken; caudal peduncle, 2 in its length.

Dorsal, I, 8; anal, I, 4. Spines not pungent.

Ground color in preservative; buff; small, dark spots on head, darker between center of eyes and back to occipital process. Body with darker blotches arranged in four irregular bars, the first behind the dorsal origin; second, at end of dorsal base; third at adipose origin, and the fourth and most irregular, before the caudal base. Fins all spotted and blotched, the blotches becoming bands on the caudal. Traces of mottling on the lower surface of the body.

This species is deeper than any of those previously described except *megacephalus*, with which it does not agree in other characters.

***Panaque purusiensis*, new species**

DESCRIPTION OF TYPE.—Number 12600, American Museum of Natural History; collected in the Rio Purus, Brazil, 1934, by Boris A. Krukoff. Our only specimen.

Length to base of caudal, 114 mm.; depth in this length, 4.4; head, to posterior margin of temporal plate, 3. Eye in head, 9; interorbital, 2.4; snout, 1.7. Head nearly as long as broad, and one and three-quarters times as long as deep. Six spoon-shaped teeth on each ramus of the upper jaw, 5 on each ramus of lower jaw. Snout narrowed anteriorly, supraorbital edges only slightly raised. Supraoccipital with very low median ridge, ending posteriorly in a point; temporal plates not carinate; interoperculum armed with a bunch of bristles, permanently everted, the longest one-fourth the length of head. Scutes spinulose, very weakly carinate, most so on either side of the dorsal and on the anterior five scutes following the clavicle. Not carinate on peduncle except the last two rows which are very weakly so; 25 scutes

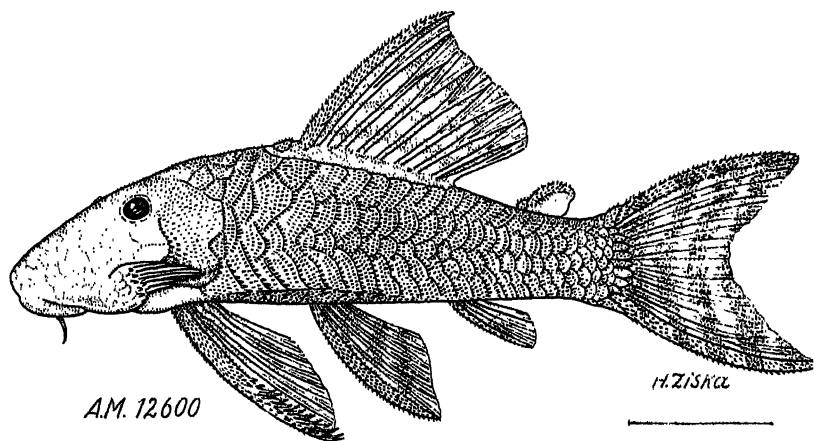


Fig. 3. *Panaque purusiensis*, new species.

in longitudinal series, 5 between dorsal and adipose, 11 between anal and caudal. Supraoccipital bordered posteriorly by 3 scutes on each side. Lower surface of head and abdomen completely covered with small granular scales.

Dorsal, I, 8, the last ray attached to the following scute by an inconspicuous membrane. Length of the base of dorsal (measured, after Regan, from first branched ray to last, exclusive of spine and of membrane following the last ray) equal to the distance three-fourths of the way to the tip of adipose. Anal, I, 4. Pectoral spine extending to middle of ventral fin. Caudal deeply emarginate; caudal peduncle twice as long as deep.

Color in preservative olivaceous with faint traces of alternate light and dark stripes from the back of the head to the caudal base, and on the sides of the body. All fins with about three dark bands which begin on the spines and may be composed of large dots; two bands on the adipose. The ventral surface is faintly mottled as if there had been dark markings.

This species differs from others described in the number of scutes bordering the supraoccipital; in its depth; the fact that the temporal plates are not carinate; its dorsal count, the length of the interopercular spines; and the tooth count which is lower than that of the other species.

***Harttia filamentosa*, new species**

DESCRIPTION OF TYPE.—Number 12616, American Museum of Natural History; collected in the Rio Jurua, Brazil, 1934, by Boris A. Krukoff.

Length to base of caudal, 145 mm.; depth in this length, 7.3; head, to posterior end of occipital process, 5.2. Eye in head, 7, interorbital, 3; snout, 1.7. Head twice as long as deep; no orbital notch. Teeth setiform. Barbel minute. Scutes 28 in lateral series. There are no keels in front of the dorsal; from behind the dorsal base there is a dorsal series of plate-like scutes, smooth and enamel-like except for a small spinulose patch on the lateral edges and the posterior denticulate margin. The

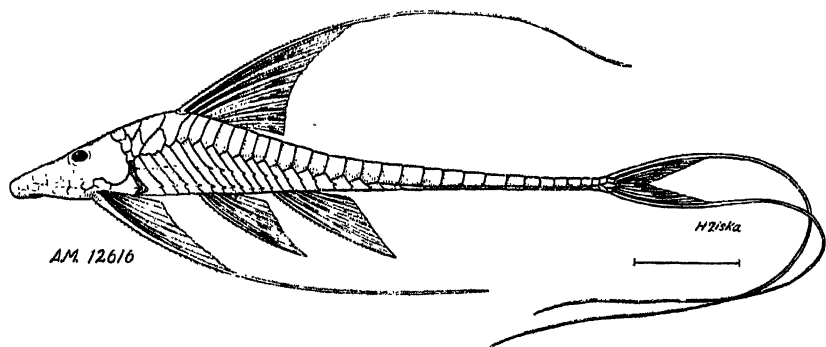


Fig. 4. *Harttia filamentosa*, new species.

second series of scutes below the origin of the dorsal is weakly bicarinate for about 7 scutes. These and the lateral series are more or less carinate from shoulder to tail; the lateral and the series above it approximate on the sixteenth scute and fuse shortly after. The ventral surface is covered with spinulose scutes up to the margin of the lower lip. There are 10 lateral plates with numerous smaller ones in between, about 7 series in mid-abdomen, 13 just before origin of pectoral.

Dorsal, 1, 7; anal, 1, 5. The dorsal filament reaches to beyond the base of the caudal; the pectoral filament reaches half the length of the longest anal ray beyond the anal; the caudal filaments, on both lobes, are four times the length of the longest caudal rays.

Color in preservative light pinkish-brown on body; yellowish on head. There is a slightly curved, darker band about two orbits wide running from just below the posterior border of eye forward to below the rim of the snout. A round dark spot about an orbit in diameter lies in the center of the occipital process. A dorsal stripe begins

behind the dorsal base and runs down the dorsal series of scutes; this is made up of a dark spot in the center of each pinkish plate-scut; a median longitudinal stripe begins in the middle of the body about under the dorsal origin and runs down below the posterior base of the dorsal to the marginal scutes, and thence to the caudal base.

The spine, filament, and first two and a half dorsal rays and their membranes are blackish. Pectoral spine and filament are unmarked, light, but there are dots or blotches on the upper half of the fin. The first branched anal ray is black. Caudal has one and a half rays next the outer black on both lobes.

Cotype

161 mm.

Rio Jurua

Because of the small amount of material previously collected from this locality, I am listing the entire Krukoff Amazonas collection below. The asterisk (*) indicates not previously recorded for either locality. When not otherwise indicated, specimens were brought in from both Rio Purus and Rio Jurua. No previous records of material listed below are from Rio Purus.

ASPREDINIDAE

- * *Bunocephalus bicolor* Steindachner.....Jurua

SILURIDAE

- Pimelodus clarias* (Bloch)
 * *Pimelodella cristata* (Müller and Troschel).....Purus
 * *Duopalatinus goeldi* (Steindachner)
Hemisorubim platyrhynchos (Cuvier and Valenciennes)
Sorubim lima (Bloch and Schneider)
 * *Sorubimichthys planiceps* (Agassiz).....Jurua
 * *Doras granulatus* Valenciennes.....Jurua
Hemidoras bachii Boulenger

In specimens from both localities, the maxillary barbel is fringed.

CALLICHTHYIDAE

- * *Callichthys callichthys* Linnaeus.....Jurua
 * *Hoplosternum littorale* (Fancok).....Purus

Loricariidae

- * *Plecostomus plecostomus* (Linnaeus).....Jurua
P. emarginatus (Cuvier and Valenciennes)
 * *P. micropunctatus*, n. sp.
 * *P. spinosissimus* Steindachner.....Purus
 * *Hemiancistrus brevis*, n. sp.....Purus
 * *H. bachii* (Boulenger).....Purus
 * *Lasiancistrus pictus* (Castelnau).....Purus
 * *Panaque purusiensis*, n. sp.....Purus
 * *Panaque coeliodon* (Steindachner).....Purus

There seems to be no adequate color description of this species in the literature.

Ground color (of specimen 114 mm.), in preservative, lightish buff. Very small dark spots profusely and irregularly scattered over head from anterior margin of eye forward. From same point backward, the spots

become larger, increasing in size toward the caudal until they are blotches. Two spots on adjacent scutes are often confluent. On the occipital process there is a central dot on either side of the ridge, encircled by about five others. Spots on the posterior surface irregular and faint.

- * *Ancistrus temminckii* (Cuvier and Valenciennes).....Purus
- Loricaria cataphracta* Linnaeus.....Jurua
- * *L. maculata* Bloch.....Jurua
- L. lima* Kner.....Jurua

A variety of this, *L. lima microlepidota*, is described by Steindachner (1907, Anz. Akad. Wien, XLIV, p. 152) from Jurua.

- * *L. evansii* Boulenger.....Purus
- * *L. lamina* Günther.....Purus
- * *L. carinata* Castelnau.....Purus
- * *L. phoxocephala* Eigenmann and Eigenmann.....Purus
- * *Harttia filamentosa*, n. sp.....Jurua
- * *Sturisoma lyra* Regan

It is interesting to note that there is no variation of characters in six specimens ranging from 113 to 174 mm.

- Farlowella gladius* (Boulenger).....Jurua

CHARACIDAE

- * *Psectrogaster rhomboides* Eigenmann and Eigenmann.....Purus
- * *Psectrogaster amazonica* Eigenmann
- * *Curimatella serpa* (Eigenmann and Eigenmann).....Purus
- * *Curimatus leuciscus* Günther.....Purus
- * *C. laticeps* Cuvier and Valenciennes.....Purus
- * *C. latior* (Spix)
- * *C. isognathus* Eigenmann.....Purus
- * *C. elegans* Steindachner.....Jurua
- * *C. spilurus* Günther.....Jurua
- * *Prochilodus nigricans* Agassiz
- * *Schizodon fasciatus* (Spix).....Purus
- * *Leporinus frederici* Bloch.....Purus
- * *L. nigrolaeniatus* (Schomburgk).....Purus
- * *Brycon hilarii* (Cuvier and Valenciennes).....Jurua
- * *Aspionax* sp. probably *gracilior*.....Jurua
- * *A. maximus* (Steindachner).....Jurua
- * *Tetragonopterus argenteus* Cuvier
- * *Chalceus macrolepidotus* Cuvier.....Jurua
- Gasteropeleus stellatus* Kner.....Purus
- * *Carnegiella strigata* (Günther).....Jurua
- Thoracocharax* sp.....Jurua
- * *Chalcinus angulatus* Spix
- * *Stethaprion crenatus* Eigenmann.....Purus
- * *Serrasalmo rhombus* (Linnaeus).....Purus
- * *S. maculatus* Kner.....Jurua
- Mylossoma albiscopeus* (Cope)
- Hydrolycus pectoralis* (Günther).....Purus
- * *Charax gibbosus* (Linnaeus).....Purus

<i>C. limaesquamis</i> (Cope).....	Jurua
* <i>Rocboides myersi</i> Gill.....	Jurua
* <i>Eucynopterus humeralis</i> (Valenciennes).....	Purus
* <i>Salminus hilarii</i> Cuvier and Valenciennes.....	Purus
* <i>Hoplias macrophthalmus</i> (Pellegrin).....	Purus
* <i>Hoplerythrinus unilaciniatus</i> (Spix).....	Jurua
GYMNOTIDÆ	
<i>Eigenmannia virescens</i> (Boulenger).....	Purus
* <i>Sternopygus macrurus</i> (Bloch and Schneider).....	Purus
SCIAENIDÆ	
* <i>Plagioscion surinamensis</i> (Bleeker).....	Purus
* <i>Pachyurus bonariensis</i> Steindachner.....	Purus
CICHLIDÆ	
* <i>Acara tetramerus</i> Heckel.....	Purus
* <i>A. vittata</i> Heckel.....	Purus
SOLEIDÆ	
* <i>Achirus jenynsii</i> (Günther)	

59.88, 6 (85)

STUDIES OF PERUVIAN BIRDS. XVII¹NOTES ON THE GENERA *SYNDACTYLA*, *ANABACERTHIA*, *PHILYDOR*,
AND *AUTOMOLUS*

BY JOHN T. ZIMMER

As in previous papers, the names of colors are capitalized when direct comparison has been made with Ridgway's 'Color Standards and Color Nomenclature.'

I am greatly indebted to Mr. N. B. Kinnear of the British Museum for notes on certain critical specimens in that institution; also to Dr. J. Domaniewski of the Warsaw Museum for the loan of important material used in the following studies.

Syndactyla rufosuperciliata cabanisi (Taczanowski)

Anabazenops cabanisi TACZANOWSKI, 1874, P. Z. S. London, p. 528—Pumamarca, Perú; ♂; type formerly in Warsaw Mus., now lost.

The present form ranges throughout the Subtropical Zone of Perú except on the Pacific side of the Andes where another subspecies replaces it. There are several gaps in the known distributional line, but these should be filled when more extensive collections are obtained in the critical regions.

An adult male from Chaupe, near the Río Chinchipe, northern Perú, is very slightly lighter in dorsal coloration than the remainder of the series and has the throat a trifle more deeply yellowish, in which respects it shows a slight tendency toward the form of the coastal slopes.

A young female from Chaupe has the upper parts somewhat darker than any of the adults, and the borders of the pale markings of the under parts darker and more sooty, especially at the tips of the feathers. It is quite readily separable from a young specimen of *similis* by its much darker upper parts and somewhat warmer under parts.

A nearly adult male from Roquefalta, Prov. Cochabamba, Bolivia, is more like the adults, though it is darker above and below. It is to be referred to *cabanisi*, although the latter form appears to reach the Amazonian drainage at Vermejo, near Santa Cruz, from which we have a

¹Earlier papers in this series comprise American Museum Novitates Nos. 500, 509, 523, 524, 538, 545, 558, 584, 646, 647, 668, 703, 728, 753, 756, and 757.

single male. Peruvian records are from Punamarca, Tambillo, Coccocho, Achamal, Chirimoto, and Ninabamba.

I am forced to revert to the name *Syndactyla* for this genus through the provision of the 'International Code of Zoological Nomenclature' which considers this name as not preoccupied by *Syndactylus*.

***Syndactyla rufosuperciliata similis* (Chapman)**

Xenotistes rufosuperciliatus similis CHAPMAN, 1927 (February 19), Amer. Mus. Novitates, No. 250, p. 3—Chugur, west of Cajamarca; ♂; Amer. Mus. Nat. Hist.

The extremely close resemblance of this form to typical *rufosuperciliata* has been pointed out by Dr. Chapman in the original description. It is a good example of the resemblance not uncommonly found in conspecific living at opposite peripheral points in the specific range.

A young bird of undetermined sex is rather paler and grayer above than the adults, with the superciliary stripe notably paler. The under parts have the feathers all strongly margined with sooty brown, leaving the central areas much more sharply defined than in the adults though of a lighter, less buffy tone than in a young female of *cabanisi* described on a preceding page.

This subspecies is known from a single locality on the western side of the western Andes in Perú.

SPECIMENS EXAMINED

S. r. similis.—PERÚ: Chugur, 2 ♂ (incl. type), 1 ♀; 1 (?).

S. r. cabanisi.—PERÚ: Chaupe, 1 ♂, 1 ♀; Uchco, 1 ♀; Chelpe, 1 ♂, 1 (?); Tulumayo, 1 ♀; Santo Domingo, 1 ♂, 1 ♀. BOLIVIA: Roquefalta, 1 ♂.

S. r. oleaginea.—BOLIVIA: Vermejo, 1 ♂. ARGENTINA: Sarmiento, 2 ♂, 1 ♀; Tafi Trail, Tucuman, 4 ♂, 2 ♀; above San Pablo, Tucuman, 9 ♂, 12 ♀.

S. r. acrita.—PARAGUAY: Colonia Independencia, 3 ♂, 1 ♀. ARGENTINA: Puerto Segundo, Misiones, 1 ♀; Santa Ana, Misiones, 1 ♂. BRAZIL: São Lourenço, Rio Grande do Sul, 1 ♂.

S. r. rufosuperciliata.—BRAZIL: São Paulo, Itaituba, 1 ♂; Rio, Terceiro, 1 ♀; Maceiras, 3 ♂, 2 ♀; alto Itatiaya, 1 ♀; La Raiz, 1 ♀.

***Syndactyla subalaris colligata*, new subspecies**

TYPE from Chaupe, northern Perú (between Tamborapa and San Ignacio), altitude 6100 feet. Adult female collected April 16, 1923, by Harry Watkins.

DIAGNOSIS.—Similar to *S. s. mentalis*, of eastern Ecuador, in general appearance, but chin and throat as broadly immaculate yellowish as in *S. s. subalaris*, and pale areas a little deeper yellow; head and mantle strongly streaked as in *mentalis* but clearer brown, without the fuscous tinge of *mentalis*, and more sharply defined against the blackish area of the hind neck and anterior part of mantle.

RANGE.—Subtropical Zone between the Chinchipe and Huancabamba rivers, northwestern Perú.

DESCRIPTION OF TYPE. Top of head blackish, with strong shaft-streaks of Straw Yellow; hind neck similar, but with streaks much broader and a little paler yellow; mantle Raw Umber, tinged with Prout's Brown and strongly streaked like the head; rump on upper portion brown like the mantle but with the streaks reduced to inconspicuous yellowish shaft-lines; posteriorly, the rump becomes bright Auburn X Chestnut, continued more deeply on the upper tail-coverts where the shaft-lines become obsolete on the longest feathers. Lores whitish with a slight yellowish tinge; the most lateral of the streaks on the crown forming a not especially conspicuous superciliary stripe, slightly wider and less deeply yellowish over the auriculars which are of the same pale yellowish color, margined with dusky; malar region with broad buffy shaft-stripes, margined with dark brown; chin and throat broadly Pinard Yellow, immaculate; breast and sides with broad shaft-stripes the color of the throat, laterally margined with dark Dresden Brown; the stripes continued down the belly, reduced in size especially in the middle of the belly; flanks and femoral tracts warm Dresden Brown with streaks nearly or quite obsolete; shorter under tail-coverts warm Dresden Brown, broadly striped with yellow along shafts; longest coverts Auburn X Sanford's Brown on exposed portions, this color also tinging the adjacent, more basal ones. Wings sooty, with exposed outer surfaces Saccardo's Umber; median and lesser upper coverts with dusky centers; inner ones with pale shaft-streaks; primary-coverts darker than the other upper wing-coverts, blackish with outer margins near Clove Brown; inner margins of remiges Cinnamon-Buff; under primary-coverts the same; rest of under wing-coverts and axillars and the carpal margin Ochraceous-Orange X Ochraceous-Tawny. Tail light Chestnut X Bay. Maxilla (in dried skin) black; mandible dull blackish along tomia; dull yellowish along gonys; feet dusky brown. Wing, 87.5 mm.; tail, 82; exposed culmen, 16.5; culmen from base, 20.75; tarsus, 21.

REMARKS.—Young females are much like the adult above though with some of the pale markings on the top of the head variably bright rufescent. Chin and upper throat pale yellowish, with strong dusky tips, the lateral and lowermost feathers tinged with orange-ochraceous; chest, posterior part of malar region, breast, and sides orange-ochraceous with some trace of pale shaft-lines or areas; lower under parts much as in the adult but less strongly striped; wings and tail about as in the adult.

This form clearly combines the characters of *mentalis* and *subalaris* though it is not intermediate in the sense that its characters are halfway between those of the other two forms; above, it is a strongly marked *mentalis*; below it is a strongly marked *subalaris* with an unusually strong yellowish tone.

In *mentalis* the yellowish gular patch is quite small and rounded posteriorly, and the feathers of the most of the lower throat are broadly margined with olive brown, with a decidedly spotted effect. In the present form, almost the whole throat is broadly yellow without dark margins above the chest, and on the chest and breast the pale marks are broader than in *mentalis*, with a more striped appearance.

***Syndactyla subalaris ruficrissa* (Carriker)**

Xenocastes subalaris ruficrissa CARRIKER, 1930, Proc. Acad. Nat. Sci. Phila., LXXXII, p. 372—Eneñas, Perú; ♀; Acad. Nat. Sci. Phila.

I have not seen this form, described from central Perú. It is said to have the gular patch even more restricted than in *mentalis*, uropygium and crissum more strongly rufescent, and the back more extensively blackish. In these respects there seems to be a close approach to the appearance of *Thripadectes holostictus* though the latter is not so prominently streaked on the belly as the members of the *Syndactyla subalaris* group. The larger, heavier, and more broadly ridged bill of *ruficrissa* also must suggest *Thripadectes* though the resemblance is probably only superficial.

SPECIMENS EXAMINED

S. s. lineatus.—COSTA RICA: 1 ♂. PANAMÁ: Boqueron, Chiriquí, 2 ♂.

S. s. tucarcunae.—PANAMÁ: east slopes of Mt. Tacarcuna, 5 ♂ (incl. type), 5 ♀; Tacarcuna, 1 ♂, 2 ♀, 1 (?).

S. s. subalaris.—COLOMBIA: Miraflores, 1 ♂ (type of *X. s. columbianus*); San Antonio, 1 (?); Las Lomitas, 2 (?); Río Cauca, 1 ♀; La Frijolera, 1 ♂; Gallera, 1 (?); Salencio, 1 ♂; Cerro Munchique, 1 (?). ECUADOR: Codo, Río Chimbo, 1 ♂; Zaruma, 1 ♂, 2 ♀, 1 (?); El Chiral, 2 ♂, 2 ♀; Mindo, 1 ♂; Río Blanco, below Mindo, 1 (?).

S. s. colligata.—PERÚ: Chaupe, 3 ♀ (incl. type).

S. s. striolatus.—COLOMBIA: La Candela, 2 ♀; Buena Vista, above Villavicencio, 1 ♀.

S. s. mentalis.—ECUADOR: Baeza, 1 ♂; lower Sumaco, 3 ♂, 1 ♀; Oyacachi, 1 ♂.

***Anabacerthia striaticollis montana* (Tschudi)**

A(nabates) montanus TSCHUDI, 1844 (May), Arch. Naturg., X (1), p. 295 Perú; Mus. Neuchâtel.

Xenicopsoides montanus jelskii STOLZMANN, 1926 (December 31), Ann. Zool. Mus. Pol. Hist. Nat., V, p. 221 -Maraynioc, Perú; Warsaw Mus.

Specimens from northern Perú and eastern Ecuador show no recognizable differentiation from typical examples taken in central Perú although there is an apparent hiatus in the range between these two areas.

Through the kindness of Dr. Domaniewski I have been able to examine the type of "*Xenicopsoides montanus jelskii*" which proves to be similar to true *montana* in all respects except that of color. The specimen is warmer brown than fresh *montana* and has the pale areas white instead of yellow. In other words, the yellow pigments of *montana* are lacking throughout the plumage. Since yellow lipochromes are soluble in alcohol, it is possible that the type of *jelskii* was at one time preserved in spirits. The feathers are somewhat harsh and dry in appear-

ance and some of the remiges are still bedraggled, and the feet are bleached and dry exactly as they become when alcoholic specimens are later dried.

The original description of *jelskii* gives the tail-length as 87 mm., while Taczanowski, who recorded the specimen as "*Philydor montanus*," gives it as 84. Actually the tail of the type is only 65 mm.; the larger figures were evidently secured by measuring to the posterior end of the false body (the specimen was at one time mounted) instead of to the base of the tail.

In the original account of "*jelskii*," Stolzmann asserted that Taczanowski had omitted to list this specimen in his account of Jelski's collection (1874, Proc. Zool. Soc. London). As a matter of fact he did list it on p. 528 under the name of "*Philydor montanus*" although he erroneously credited it to Pumamarca. He gives the reference under "*P. montanus*" in the 'Ornithologie du Pérou' (1884, II, p. 153), where the description is that of "*jelskii*." Specimens from Pumamarca and Amable Maria were recorded and later described by Taczanowski under the name "*striaticollis*" and, from the description, obviously are typical *montana*.

Since "*jelskii*" and *montana* come from the same region, the conclusion is that "*jelskii*" is a discolored example of *montana*, differing probably because of postmortem change in coloration.

Peruvian localities for *montana*, other than those from which material has been herewith examined, are Amable Maria, Pumamarca, Ropaybamba, and Garita del Sol.

***Anabacerthia striaticollis yungae* (Chapman)**

Philydor montanus bolivianus CHAPMAN (nec *Philydor rufus bolivianus* Berlepsch, 1907), 1923 (August 28), Amer. Mus. Novitates, No. 86, p. 15—Locotal, Bolivia; ♂; Amer. Mus. Nat. Hist.

Philydor montanus yungae CHAPMAN, 1923 (November 19), Amer. Mus. Novitates, No. 96, p. 12 new name for *P. m. bolivianus* Chapman.

As noted by other workers, specimens from southeastern Perú are referable to the Bolivian form. Records are from San Antonio and Caradoc in addition to the localities from which material is now at hand.

SPECIMENS EXAMINED

A. s. montana.—PERÚ: Chelpos, 3 ♂; Utcuyacu, 1 ♂, 2 ♀; Chaupe, 3 ♂, 1 ♀; Lomo Santo, 1 ♂, 1 ♀, 1 (? = ♀); Huarandosa, 1 ♂; San Ignacio, 1 ♀; Maraynioc, 1 (?)¹ (type of *jelskii*). ECUADOR: Sabanilla, 1 ♂, 1 ♀; Guayaba, 1 ♀; lower Sumaco, 4 ♂; lower Río Sardinas, 1 ♀; Río Oyacachi, 1 ♂.

¹Specimen in Warsaw Museum.

A. s. yungae.—BOLIVIA: Locotal, 2 ♂ (incl. type), 2 ♀, 1 (?); Yungas, Prov. Cochabamba, 1 ♂, 2 (?). PERÚ: Inca Mine, 1 ♂; Santo Domingo, 2 ♀; Río Inambari (2200 feet), 3 ♀.

***Philydor pyrrhodes* (Cabanis)**

A(nabates) pyrrhodes CABANIS, 1848, in Schomburgk, 'Reisen Brit. Guiana,' III, p. 689—(coast of) British Guiana.

This widely ranging species appears to be indivisible into recognizable subspecies. There is a certain amount of individual variation in the warmth of color on the mantle and the depth of rufous on the tail. The birds from north of the Amazon (Perú to Colombia, eastern Brazil, and the Guianas) are more deeply hued than those from south of it (Teffé to Pará), but the difference is sometimes very slight and appears to be unworthy of distinction by name.

In spite of the similarity of this species to *P. e. erythrocerus* and *P. e. fuscipennis*, there appears to be no very close relationship. The present species has various points of difference which are of some significance. The lower auriculars and malar region are uniformly deep ochreous, not dusky, and there are no whitish shaft-streaks on the middle auriculars; the remiges are a little broader at the tips and the tertials are suffused with the color of the back, not clear, dark gray; the occipital feathers are long and form a semblance to a crest; the tail is graduated for one-fourth to one-fifth of the length, not merely one-tenth; the throat-feathers are whitish or ochreous basally, not gray; and the plumage in general is longer and fuller. The *erythrocerus* group presents the opposite of these features.

The only published record of this species from Perú is from Pebas, to which the present collection adds one locality which, like Pebas, is on the north bank of the Amazon.

SPECIMENS EXAMINED

P. pyrrhodes.—BRITISH GUIANA: Supenaam, 1 (?). VENEZUELA: Boca de Sina, 1 ♂; (western) foot of Mt. Duida, 1 ♂; mouth of Río Ocama, 2 ♂, 1 ♀, 1 (?); El Mercy, 1 ♂; Solano, 1 ♂. COLOMBIA: La Morelia, 1 ♀. ECUADOR: lower Río Suro, 2 ♂; upper Río Suro, 1 ♂; mouth of Río Curaray, 2 ♀; "Napo River," 1 (?). PERÚ: Puerto Indiana, 1 ♂. BRAZIL: Teffé, 1 ♂; Borba, 2 ♂; Igarapé Auará, 1 ♂, 1 ♀; Rio Tapajoz, Caxiricatuba, 1 ♂, 1 (? = ♀); Tauary, 1 ♀; Rio Tocantins, 1 ♀; Utinga, near Pará, 1 ♀; Rio Negro, Santa Isabel, 1 ♂.

***Philydor rufus bolivianus* Berlepsch**

Philydor columbianus bolivianus BERLEPSCH, 1907 (February), Ornith. XIV, p. 366—Santa Cruz de la Sierra, Bolivia; Berlepsch Coll., Frankfurt Mus.

The range of this bird in Perú is extended somewhat by the present collections. One male from Lagarto, upper Río Ucayali, and a male and a

female from Río Seco, west of Moyobamba, appear to be referable to this form. The Lagarto bird is slightly darker on the back and on the crown and nape than Bolivian examples, and has the posterior portion of the ochraceous forehead slightly varied with grayish lateral margins on the feathers. The Río Seco skins both have the forehead less strongly ochraceous than Bolivian specimens, approaching, in this respect, the west-Ecuadorian form *riveti*, but the whole coloration is paler than in that form and is nearer the hues of the Bolivian skins. The relationship of these northern birds is thus obviously closer to *bolivianus* than to *riveti*.

In an earlier paper (1930, Field Mus. Nat. Hist. Publ., Zool. Ser., XVII, p. 348) I noted a similar tendency toward a reduction of ochraceous color on the forehead in four examples from the upper Huallaga. The differences are not pronounced enough, however, to warrant the recognition of a new form based solely on this character. Apparently the more northern birds show a trend toward *riveti* while the southeastern examples approach the west-Brazilian form next to be discussed. The specimen from Lagarto is so equivocal that it would be difficult to place with certainty should a Peruvian form be recognized as distinct from the Bolivian.

An examination of considerable material from both eastern and western Brazil shows, on the other hand, that there is a definite division between *rufus* of the eastern coast and specimens from Matto Grosso. It is not perfectly clear whether the coastal birds do not deserve further division, since skins from Santa Catharina, Paraná, and Rio Grande do Sul, Brazil, and from Paraguay are somewhat paler on the back and darker on the forehead and superciliaries than individuals from São Paulo and Espírito Santo. However, several examples from near Rio de Janeiro are not so noticeably different from the more southern birds, and, since Rio de Janeiro, the proposed type locality of *rufus*, lies between São Paulo and Espírito Santo, the constancy of the characters suggested is open to question.

Accepting all the eastern birds as *rufus*, Matto Grosso specimens are recognizable by their warmer back, deeper forehead and paler crown, and may be known as follows.

***Philydor rufus chapadensis*, new subspecies**

TYPE from Chapada, Matto Grosso, Brazil. No. 33,639, American Museum of Natural History. Adult male collected July 15, 1885, by H. H. Smith.

DIAGNOSIS.—Similar to *P. r. rufus* of eastern Brazil, but back more warmly brown, crown and nape paler gray, less sharply defined from the back, and forehead deeper ochraceous with spots of the same color usually indicated at the tips of the

anterior and central crown feathers; bill heavier and apparently paler; rufous of wings averaging paler. Differs from *P. r. bolivianus* of northern Bolivia by paler back, clearer gray crown and nape, and more sharply defined frontal band.

RANGE.—Northern Matto Grosso, in the vicinity of Chapada.

DESCRIPTION OF TYPE.—Forehead deep Ochraceous-Buff, rather sharply defined from the light Mouse Gray of the crown and nape, though the anterior feathers of the crown have small dull ochraceous spots; the color of the forehead is continued posteriorly over the eyes to the sides of the neck in a broad superciliary stripe; back light Saccardo's Umber, approaching Isabella Color on the rump and upper tail-coverts. Entire under parts bright Ochraceous-Buff, deeper anteriorly and somewhat tinged with brownish on the flanks; a narrow postocular line of Mouse Gray on the upper border of the auriculars separating the superciliary stripe and the rest of the auriculars and continuous with the gray of the hind neck. Remiges largely Kaiser Brown × Hazel with dusky areas at the tips of the outer secondaries and inner primaries, increasing in extent toward the outer primaries where the rufous is restricted to the base of the inner web; tertials with a slight brownish wash; upper wing-coverts slightly lighter rufous, but alula and primary-coverts dusky, with margins very narrowly dull rufescent; under wing-coverts and axillars like the throat. Tail dark Ferruginous × Hazel with a wash of the color of the rump on the basal portion of the lateral margins. Maxilla horn-color (in dried skin); mandible dull yellowish; feet light brown. Wing, 96 mm.; tail, 92; exposed culmen, 16.25; culmen from base, 22.25; tarsus, 23.75.

REMARKS.—Females like the males but slightly smaller. Wings, 83–90 mm.; tail, 87–88; culmen from base, 20.25–22.25; tarsus, 22.5–24. Males have the wing, 91–101 mm.; tail, 88.5–92; culmen from base, 22.5–23; tarsus, 23.5–24.5.

SPECIMENS EXAMINED

P. r. rufus.—BRAZIL: Serra do Itatiaya, Ponto Marombó, 1 ♂; Monte Serrat, 2 ♀; Espírito Santo, Serra do Caparão, 1 ♂, 1 ♀; São Paulo, Alto de Serra, 1 ♂; São Sebastião, 1 ♂¹; Fazenda Cayou, 1 ♂¹, 2 ♀¹; Paraná, Corvo, 1 ♀; Tibagy, 2 ♂, 2 ♀, 2 (?); Santa Catharina, Salto Pirahy, 2 ♂; Ouro Verde, 2 ♂, 1 ♀, 1 (?); Rio Grande do Sul, Ilansu, 1 ♀; Lagoa Vermelha, 1 ♂, 2 ♀; Erebango, 1 ♀; Nonohay, 4 ♂, 2 ♀, 2 (?). PARAGUAY: east of Villa Rica, 2 ♂; Abai, 1 ♂, 1 (?).

P. r. chapadensis. BRAZIL: Matto Grosso, Chapada, 11 ♂ (incl. type), 5 ♀.

P. r. bolivianus. BOLIVIA: Vermejo, 3 ♂, 1 ♀. PERU: Lagarto, upper Ucayali, 1 ♂; Rio Seco, west of Moyobamba, 1 ♂, 1 ♀; Huachipa, 1 ♂¹; Vista Alegre, 3 ♀¹.

P. r. riveti.—ECUADOR: Guala, 1 ♂; Mindo, 1 ♂.

Philydor ruficaudatus (D'Orbigny and Lafresnaye)

Anabates ruficaudatus D'ORBIGNY AND LAFRESNAYE, 1838, 'Syn. Av.', 2, in Mag. Zool., VIII, cl. 2, p. 15—Yuracares, Bolivia; Paris Mus.

Anabates ruficaudus SCLATER, 1858, P. Z. S. London, XXVI, p. 456—Gualaquiza, Ecuador—(nom. emend.).

¹Specimens in Field Museum of Natural History, Chicago.

Philydor subflavescens CABANIS, 1873, Jour. für Orn., XXI, p. 66—Monterico, n. c. Ayacucho, Perú; Berlin Mus.

Anabazenops immaculatus ALLEN, 1889, Bull. Amer. Mus. Nat. Hist., II, p. 92—northern Bolivia; Amer. Mus. Nat. Hist.

Philydor euphrys BERLEPSCH AND STOLZMANN, 1896, P. Z. S. London, p. 375, in text —La Gloria, Perú; ♀ (juv.); Warsaw Mus.

Twenty-six specimens from various localities show no particular divergencies correlated with distribution. Several examples are in immature plumage and show such lack of certain characters attributed to the young of this species that it is evident there has been some earlier confusion with another species. The conflict proves to have been with *subfulvus*, and a full discussion will be found in the treatment of that form.

I have been unable to find any close relatives of *ruficaudatus*. Some of its characteristics are such that it could find an equally suitable position in the genus *Anabacerthia*, but in other respects it might be out of place there. In any case it appears to bear no very close relationship with *subfulvus*.

Owing to the confusion which has existed, it is impossible to be certain of all the records which properly belong to this species, but with the help of occasional descriptive notes, the following Peruvian localities have been taken to belong here: Monterico, La Gloria, Cosfipata, and Yahuarmayo. Other localities are shown in the list of material examined, which follows the account of the next species.

***Philydor erythrocerus subfulvus* Sclater**

Philydor subfulvus SCLATER, 1861 (November), P. Z. S. London, p. 377—Gualaquiza, Ecuador.

A series of twenty-two specimens of this form from northern Perú, eastern Ecuador, and southeastern Colombia, together with twenty-six skins of *Philydor ruficaudatus*, has permitted a careful analysis of the characters which are distinctive of the two groups, in which there appears to have been some confusion. Both occur together over a considerable range.

The series of *ruficaudatus* contains several specimens of undoubted immaturity, judging by the acuteness of the rectrices and the comparative fluffiness of the plumage, but without exception they fail to show any definite rufescence on the margins of the upper tail-coverts as described for the young of this species. The back is, furthermore, not brownish but a duller or grayer tone of olive green than is shown by the adults. The under parts are hardly more fluffy than in the adults, but are a little

paler and duller yellow of the same hue as in the full-grown birds. The sides of the head are, however, different, and are inclined to bright orange-ochraceous on the lores, superciliary stripe, lower half of the auriculars, and a malar stripe reaching to the base of the bill. This stripe is rather sharply defined from the paler yellow of the throat which encroaches on the lower margin of the malar space. The under wing-coverts are deep buff but are hardly darker than the inner margins of the remiges which, in turn, are rather sharply defined from the dark portion of the web.

The immature specimens of *P. e. subfulvus* are quite distinct (I exclude *P. e. ochrolaemus* of southeastern Perú and Bolivia which is a separate form as will be discussed later). Here the upper tail-coverts are strongly rufous with only an ill-defined dusky area near the shaft; the lower rump is suffused with rufous; the mantle and top of the head are brown; the superciliary stripe is orange-ochraceous but the malar region is rather exactly like the throat or, if slightly deeper than the gular midline, it grades insensibly into it. Posteriorly, the malar area is more deeply tinged with orange-rufous and this color is carried behind the auriculars to the sides of the neck and even to the hind neck, while anteriorly it becomes diluted. The entire group of auricular feathers is relatively uniformly blackish (sometimes dark brown like the top of the head), with pale shafts or shaft-stripes, and this dusky color is carried beneath the eye to the base of the mandible in a narrow stripe on the upper margin of the malar region. The under parts are like the lower throat, buffy or orange-ochraceous as the case may be, with the under tail-coverts quite strongly rufescent and the flanks brownish. The under wing-coverts are deeply cinnamon-rufous, notably more intensely colored than the inner margins of the remiges which are not quite so sharply defined as in *P. ruficaudatus*.

These characters are adequate to place any of the young birds. The interesting discovery has been that the adults of *subfulvus* are quite easily separable from those of *P. e. ochrolaemus* which, in superficial respects, they resemble much less than they do the adults of *ruficaudatus*. The young of *subfulvus* are relatively similar to the adults of *ochrolaemus* except for more grayish, less rufescent, wings; darker and duller dorsum; less extensive rufous color on the rump; and paler throat. The adults of *subfulvus* have the under parts dull pale buff; without any orange tints (though without the primrose-yellow tints of *ruficaudatus*); the back is more olive than that of the juvenals (but decidedly browner than in *ruficaudatus*); the uropygium is about as in the juvenals, decidedly rufescent, at least on the margins and tips of the upper tail-

coverts (and molting examples are renewing this feature unaltered); the superciliary stripe is deeper buff than the throat; the dusky area involving all the auriculars, the subocular space, and a line over the malar area to the base of the mandible is as in the juvenals, in decided contrast to the condition in *ruficaudatus*.

Taczanowski's description of this form in the 'Ornithologie du Pérou,' II, p. 152, is very good for the adult and belongs where he placed it, not under *ruficaudatus* where it has since been transferred.

One feature, which undoubtedly has much to do with the confusion, is that the adult plumage of *subfulvus* is rather looser in texture than that of adult *ruficaudatus*, which gives a wrong impression of immaturity. The immature *subfulvus* has even more decomposed plumage.

I have no hesitation in assigning *subfulvus* to the *erythrocerus* group on examination of nearly a hundred examples of the two forms hitherto assigned to this group. The general resemblance is very striking in almost all respects. The same facial characteristics exist in distinction to *ruficaudatus*; the contrasting areas of the under side of the wing are similar; the texture of the plumage is the same; and other features are shared in common. True *erythrocerus* is much more olive in color, but *lyra* is decidedly brownish, though both these have more rufous on the uropygium than does *subfulvus*. A single immature example of *erythrocerus*, from Faro, Brazil, is strikingly similar to the juvenals of *subfulvus*, with the superciliary stripe, sides of neck, and under tail-coverts notably orange-rufous.

In general, *subfulvus* has a shorter tail than *ruficaudatus* (♂, 59–69.25 mm. as against 69–77.5; ♀, 55–67 as against 63–65.5). The measurements given by Selater for the type of *subfulvus* show the tail 2.8 inches (=71.12 mm.), which is larger than in any of the examples that I have referred to that form. However, Mr. Kinnear writes me from the British Museum that this type has the auriculars all dark in color like the top of the head, with a dark line continued forward below the eye to the base of the bill; the malar region is like the throat, not decidedly more orange-rufous; the rump is somewhat more rufescent than the mantle and the upper tail-coverts distinctly more so though not so markedly rufous as in an example from Cosñipata. These points leave no doubt of its agreement with the series now before me which I have referred to *subfulvus*. The Cosñipata bird is equally certainly referable to *ochrogaster* which differs from *subfulvus* in the manner stated.

Mr. Kinnear further remarks that a specimen of *P. ruficaudatus*, also from Cosñipata, has a dark line below the eye as in *subfulvus*.

Among the specimens of *ruficaudatus* at hand I can find none in which this line is so well developed as in most *subfulvus*, although an occasional skin shows a suggestion of such marking very poorly developed. On the other hand a young male of *subfulvus* from the Río Suno has the stripe rather poorly developed, although in other respects it is in perfect agreement with other members of its subspecies. Apparently this feature is not of absolute constancy, although in the great majority of cases it is quite serviceable as a taxonomic criterion. The presence or absence of rufous on the uropygium appears to be quite constant. The only records assignable to *subfulvus* from Perú are those from Anayacu and Pomará included in the material listed below.

***Philydor erythrocercus lyra* Cherrie**

Philydor erythrocercus lyra CHERRIE, 1916, Bull. Amer. Mus. Nat. Hist., XXXV, p. 186—6th of March Rapids, Rio Roosevelt, Brazil; ♀; Amer. Mus. Nat. Hist.

Seventy-five specimens from regions south of the Amazon, from Para to eastern Perú, can not be satisfactorily subdivided. The birds from the easternmost localities tend to approach the coloration of typical *erythrocercus*, being slightly more greenish (less brownish) olive and more yellowish (less buffy) below, though the brown wings and rufous shoulder-patch are less modified. Birds from the westernmost localities are somewhat duller above with a trace of grayish, while the skins from more central regions are brownest, reaching the maximum on the Ciy-Paraná and the upper Rio Roosevelt whence the form was described. There is such a gradual transition from one extreme to the other that it is impossible to draw a definite line segregating any distinctive races and the form is best left undivided.

Records from Perú which belong to *lyra* are from Chamicuro and Jeberos.

***Philydor erythrocercus ochrogaster* Hellmayr**

Philydor ochrogaster HELLMAYR, 1917 (February), Verh. Orn. Ges. Bayern, XIII (1), p. 111—Chanchamayo, Dept. Junín, Perú; ♂; Munich Mus.

This brightly colored bird is probably best placed in the *erythrocercus* group. The cinnamonaceous color of the wings is a little brighter than in *lyra* and the rufous of the uropygium perhaps a little darker, but in dorsal aspect there is much resemblance between these two forms. In ventral aspect, *ochrogaster* is more intensely colored than any other form of the group, although immature examples of *subfulvus* go far in its direction. One young male from Zamora, Ecuador, and a young female from Pomará, Perú, have the throat as strongly ochraceous as the

breast, but they have dull-colored wings and back and the rufous of the uropygium is much reduced and confined to the margins of the feathers. They belong without question to *subfulvus*, though in ventral aspect they suggest *ochrogaster*.

The dusky line from the auriculars to the base of the bill is not so strongly developed in *ochrogaster* as in *erythrocerus*, *lyra*, and *subfulvus*, but is more pronounced than in *P. ruficaudatus*.

In general, *ochrogaster* is thus intermediate between *lyra* and *subfulvus*, having the cinnamonaceous wings of the former and the ochraceous under parts of the young of the latter, both in greater intensity, while the rufous of the uropygium is developed to an exactly intermediate degree. The olive tone of the head and mantle approaches the condition of true *erythrocerus* although it is not so clear in tone.

Records of *ochrogaster* from Perú are from Chanchamayo, La Gloria, Huaynapata, Marcapata, and Cosñipata, and other localities are added below.

After careful comparison of the *erythrocerus* group with *erythronotus* and *fuscipennis*, I am convinced of the close relationship existing among them. The gray wings of *erythronotus* and *fuscipennis* are reflected in the clouded remiges and upper wing-coverts of *subfulvus* which are darker than in *erythrocerus*, *lyra*, and *ochrogaster*. The ochraceous color of the under parts is similar to the hue in immature *subfulvus* and *erythrocerus*, and the bright rufescence of the hind neck and sides of neck similarly finds its counterpart. The proportions and actual measurements are much the same. The coloration of the auriculars and malar region shows the same characteristic pattern, and other details of coloration follow a similar design.

With regard to the proper differentiation of *erythronotus* and *fuscipennis*, I am unable to draw final conclusions owing to lack of Colombian material. Two specimens from the Chimbo region of northwestern Ecuador differ slightly from a series of sixteen birds from eastern Panamá by somewhat lighter and clearer coloration. On the other hand, six specimens from western Panamá are darker and deeper in coloration than those from the eastern part of the same country. Presumably the west-Panamanian birds represent *fuscipennis* and the east-Panamanian and west-Ecuadorian examples *erythronotus*, but of the latter I do not know which is more typical. Judging by plate VII, in volume XV of the 'Catalogue of Birds,' the west-Ecuadorian birds are the nearer to true *erythronotus*; the east-Panamanian series is then rather exactly intermediate between it and *fuscipennis*, though closer to *erythronotus*.

With this association, the range of the species may be divided on easily established lines. The typical form, *erythrocerus*, inhabits the north bank of the lower Amazon, reaching northward into the Guianas but apparently not west of the Rio Negro; *lyra* inhabits the entire south bank of the Amazon, reaching northern Maranhão to the eastward and extending up various tributaries to the southward, though not reaching any considerable elevation; *ochrogaster* inhabits central and southern Perú and northwestern Bolivia at slightly higher elevations than *lyra* though still within the tropical zone; *subfulvus* replaces *lyra* north of the Amazon in northern Perú and eastern Ecuador, reaching southeastern Colombia; *erythronotus* inhabits the area extending from northwestern Ecuador through central Colombia to eastern Panamá; and *fuscipennis* occupies at least the Caribbean side of western Panamá.

The resemblance of *erythronotus* and *fuscipennis* to *Philydor pyrrhodes* I believe to be purely casual and not a sign of close relationship. *P. pyrrhodes* is a widely ranging species which occupies portions of the ranges of various members of the *erythrocerus* group in addition to certain regions from which the latter are not known, but resemblance appears only in the cases of *erythronotus* and *fuscipennis* whose ranges are separate from that of *pyrrhodes*.

SPECIMENS EXAMINED

P. e. erythrocerus.—BRAZIL: Faro (Castanhal), 12 ♂, 7 ♀. BRITISH GUIANA: Tumatumari, 1 ♀.

P. e. lyra.—BRAZIL: Rio Roosevelt, 6th of March Rapids, 1 ♀ (type); Barão Melgaço, 1 ♂; Utinga, near Pará, 2 ♂, 1 ♀; Rio Tocantins, Baião, 1 ♂; Baião (Pedral), 4 ♂, 4 ♀; Mocajuba, 2 ♀; Rio Curuá, Ilha Malocca, 1 ♂; Rio Majary, Recreio, 1 ♂; Rio Xingú, Tapará, 3 ♂, 2 ♀; Porto de Moz, 1 ♀; Villarinho do Monte, 1 ♂, 2 ♀; Rio Tapájoz, Tauary, 1 ♂; Piquiatuba, 1 ♂; Caxiricatuba, 4 ♂, 2 ♀; Igarapé Brabo, 6 ♂, 2 ♀; Limóil, 1 ♂, 1 ♀; Rio Amazonas, Villa Bella Imperatriz (Serra de Parintins), 3 ♂, 1 ♀; (Lago Andirá), 4 ♂, 7 ♀; Rio Madeira, Igarapé Auará, 6 ♂, 5 ♀; Rosarinho (Lago Sampaio), 1 ♂; Tefé, 1 ♀. PERÚ: Orosa, 1 ♀; Rio Ucayali, Lagarto, 1 ♂; Contamana, 1 ♀¹.

P. e. subfulvus.—ECUADOR: Rio Suno, above Avila, 2 ♂, 1 ♀, 1 (?); lower Rio Suno, 1 ♂, 1 ♀; mouth of Lagarto Cocha, 1 ♂, 1 ♀; mouth of Rio Curaray, 3 ♀; Zamora, 3 ♂; "Napo," 1 (?). COLOMBIA: La Morelia, 1 ♂, 1 ♀. PERÚ: Anayacu, 2 ♂; Pomará, 1 ♀; mouth of Rio Santiago, 1 ♂.

P. e. ochrogaster.—PERÚ: Rio Távora, 1 ♀; Marcapata, 1 ♀; Huachipa, 1 ♂¹. BOLIVIA: Mission San Antonio, 1 ♂, 1 ♀.

P. e. erythronotus.—ECUADOR: Bucay, 1 ♂; Chimbo, 1 (?). PANAMÁ: Tacarcuna, 6 ♂, 6 ♀; Tapalisa, 1 ♀; Cituro, 2 ♂, 1 ♀.

P. e. fuscipennis.—PANAMÁ: Chitrá, 1 ♀; Rio Calovénora, 2 ♂, 2 ♀; (no locality), 1 (?).

¹Specimens in Field Museum of Natural History, Chicago.

P. ruficaudatus.—ECUADOR: mouth of Río Curaray, 1 ♂, 1 ♀; below San José de Sumaco, 1 ♂, 2 ♀; Río Suno, above Avila, 4 ♂, 2 ♀; lower Río Suno, 1 ♀; above Archidona, 1 ♀. VENEZUELA: (western) foot of Mt. Duida, 1 ♂; Caño Seco, 1 ♀. BRAZIL: Río Guamá, Santa Maria de S. Miguel, 1 "♂" [?= ♀]; Barão Melgaço, 1 ♂. BOLIVIA: Mission San Antonio, 1 ♂; no locality (=n. Bolivia), 1 (?) (type of *A. immaculatus*). PERÚ: Río Ucayali, Lagarto, 3 ♂, 1 ♀; Río Seco, west of Moyobamba, 2 ♂; Río Tavera, 1 ♀; Candamo, 1 ♂.

***Automolus infuscatus infuscatus* (Sclater)**

Anabates infuscatus SCLATER, 1856, Ann. Mag. Nat. Hist., (2) XVII, p. 468—upper branches of Peruvian Amazons (Verreaux collection, 1854); British Mus.

Anabates Sclateri PELZELN, 1859, Sitzungsab. Akad. Wiss. Wien, math.-naturw. Kl., XXXIV, p. 111 (in text)—new name for *Anabates infuscatus* SCLATER (preocc. errore).

The exact site where the type of *infuscatus* was obtained is uncertain, but the question is not of great importance since the birds from both banks of the Amazon in eastern Perú are alike.

Records from Perú are from Jeberos, Chayavitas, Yurimaguas, Shanusi, and "Peruvian Amazon" to which other localities are added in the list of specimens examined. There is also a record from Cosñipata, based on a skin (or skins) collected by Whitely in 1871, but the whereabouts of the specimen are unknown. It is the only record from extreme southeastern Perú.

Comparative studies have shown that *cervicalis* has a more restricted range than heretofore supposed and that the birds from the Rio Negro of Brazil and the upper Orinoco of Venezuela deserve separate recognition. The description follows.

***Automolus infuscatus badius*, new subspecies**

TYPE from Playa del Río Base, Mt. Duida, Venezuela; altitude 550 feet. No. 273,970, American Museum of Natural History. Adult male collected November 25, 1928, by the Olalla brothers.

DIAGNOSIS. Similar to *A. i. cervicalis* of British Guiana but back distinctly warmer brown, less olivaceous, and the rufous color of the top of the head darker; under wing-coverts duller, less brightly rufescent.

RANGE. Southwestern Venezuela, on the upper Orinoco and Caura rivers, the vicinity of Mt. Duida, and the Cassiquiare region, ranging along the right bank of the Rio Negro, Brazil, to (near) the mouth of that stream.

DESCRIPTION OF TYPE. --Top of head slightly crested, Prout's Brown; back anteriorly warm dark Brussels Brown with a tinge of Saccardo's Umber; lower back more rufescent, gradually passing into bright Chestnut on the rump and upper tail-coverts. Loes dull whitish; no pronounced superciliary stripe but feathers above auriculars with brown edges and buffy shaft-streaks; auriculars and subocular feathers also with grayish-brown margins and pale shafts; lower margins paler and

not as sharply defined from the throat as in *A. i. infuscatus*; throat near Massicot Yellow; breast somewhat shaded with a dull brownish hue; belly dull buffy; sides and flanks light Olive Brown; under tail-coverts dull buff, tinged with cinnamonaceous. Wings sooty brown, with external margins near the color of the back; upper wing-coverts a little brighter; under wing-coverts dull Cinnamon-Buff with a brownish tinge, darker on the under primary-coverts; inner margins of remiges cinnamonaceous buff. Tail dark Chestnut. Maxilla blackish brown (in dried skin); mandible dull yellowish; feet dull, dark brown. Wing, 94 mm.; tail, 75; exposed culmen, 19; culmen from base, 24; tarsus, 22.

REMARKS.—Females similar to the males but averaging slightly smaller.

I have only three examples of the Guianan form, two of which are from Faro, Brazil (which has a pronouncedly Guianan avifauna), but these three agree in their characteristics and cannot be matched in a series of sixty-nine specimens of the new form. Various authors, moreover, have stated clearly that the back in *cervicalis* is olive brown (as it is in my three specimens) and it is impossible to call the color of the back in *badius* at all olive in hue. Some examples are even more warmly colored than the skin I have selected for the type, which is of average color, and though some birds, on the other hand, are a little lighter in tone, all have the warm hue that characterizes *badius*. It appears, therefore, that *cervicalis* is intermediate between *badius* and *paraensis*.

Dr. Hellmayr (1925, Field Mus. Nat. Hist. Publ., Zool. Ser., XIII (4), p. 213, footnote ^c) noted that Marabitanas and Manaos birds were more russet above than Guianan specimens of *cervicalis* but attributed the difference to postmortem change in old skins collected by Natterer. The fresh material now available shows that the character has definite existence. I have no skins from the left bank of the Rio Negro at Manaos and can not state whether the birds from that region are *badius* or, perhaps, intermediate between it and *cervicalis* of the Jamundá region. The single example from the lower Negro, across from Manaos, is typical *badius*.

SPECIMENS EXAMINED

A. i. infuscatus. PERÚ: mouth of the Río Urubamba, 1 ♂, 1 ♀; Santa Rosa, Río Ucayali, 2 ♂, 3 ♀; Lagarto, 1 ♂, 1 ♀; Puerto Bermúdez, 3 ♂¹, 2 ♀¹; Puerto Arturo, Yurimaguas, 1 ♀¹; Anayacu, 1 ♂. ECUADOR: Río Sano, above Avila, 1 ♂; lower Río Sano, 1 ♂, 2 ♀; mouth of Río Curaray, 3 ♀. COLOMBIA: Florencia, 1 ♂, 1 ♀; La Morelia, 2 ♂, 1 ♀. BRAZIL: Teffé, 2 ♂, 3 ♀.

A. i. paraensis.—BRAZIL: Rio Madeira (right bank), Igarapé Auará, 1 ♂, 1 ♀; Rio Majary, Rereio, 1 ♀; Rio Tapajoz, Igarapé Brabo, 2 ♂, 3 ♀, 1 (?); Caxiricatuba, 2 ♂; Tauary, 2 ♂, 3 ♀; Rio Xingú, Tapará, 1 ♀; Porto de Moz, 1 ♀, 1 (?);

¹Specimens in Field Museum of Natural History, Chicago.

Villarinho do Monte, 4 ♂, 2 ♀; Rio Iriri, Bocca de Curusá, 1 ♂; Rio Tocantins, Cametá, 1 ♀; Mocajuba, 3 ♂, 1 ♀; Baião, 1 ♀; Utinga, near Pará, 1 ♂; "Upper Amazon," 1 (?).

A. i. cervicalis.—BRAZIL: Faro, 1 ♂, 1 ♀. BRITISH GUIANA: Meamu mouth, 1 ♀.

A. i. badius.—VENEZUELA: Mt. Duida, Playa del Río Base 4 ♂ (incl. type), 3 ♀; Foothills Camp (Pie del Cerro) 1 ♂, 3 ♀; Caño León, 1 ♂, 1 ♀; Caño Seco, 1 ♂, 1 ♀; Río Pescada, 2 ♂; (western) foot of Mt. Duida, 2 ♂; Río Caura, La Unión, 2 ♂, 1 ♀; Río Cassiquiare, El Mercy, 2 ♂, 1 (?); opposite El Mercy, 2 ♂, 5 ♀; Solano, 1 ♂; Buena Vista, 1 ♂; Río Huaynia, junction of Río Cassiquiare, 6 ♂; Río Orinoco, mouth of Río Ocamo, 3 ♂, 2 ♀; opposite mouth of Río Ocamo, 2 ♂, 1 ♀. BRAZIL: Rio Uaupés, Tahuapunto, 3 ♂; Río Negro, Yucabi, 2 ♂, 2 ♀; Tatú, 3 ♂, 2 ♀; Tabocal, 4 ♂; Mt. Curucuryari (500 feet–2000 feet), 2 ♂, 4 ♀; Muirapinima, 1 ♀.

***Automolus dorsalis* Selater and Salvin**

Automolus dorsalis SELATER AND SALVIN, 1880, P. Z. S. London, p. 158—Sarayacu, Ecuador; British Mus.

Five skins from the Río Seco, west of Moyobamba, furnish the first evidence of the occurrence of this species in Perú. One of the skins, a young male, agrees in detail with the coloration of the type of *dorsalis* as described. Two skins from eastern Ecuador, Zamora and Zuna (Río Upano), are somewhat less strongly colored on the under parts, and there are other specimens from Colombia, Ecuador, and Perú which are in normal adult plumage except for their rufescent superciliaries. In the fully adult plumage there is no trace of ochraceous color on the sides of the head nor on the throat, breast or belly. It is obvious, however, that only a single species is involved and that the differences are ontogenetic.

Dr. Hellmayr has suggested (1925, Field Mus. Nat. Hist. Publ., Zool. Ser., XIII (4), p. 215, footnote) the possibility of relationship between *dorsalis* and *infuscatus*. The material at hand rather effectively disposes of this possibility in the negative direction. Specimens of both species are at hand from several localities in Ecuador and Colombia and a comparison of the two series shows a number of differences which are not of the sort indicated by the known subspecies of *infuscatus*.

It appears that *infuscatus* has a differently shaped bill, with the outline much more decurved in lateral aspect, the maxilla narrower toward the tip, and the culmen more sharply ridged. There is no strong semi-lunar patch of pale coloration below the eye as in *dorsalis*, and the difference in the size of the sexes is much less pronounced. In *infuscatus infuscatus*, our material shows the males to have an average wing-length of

99.3 mm.; the females, 89.8. In *dorsalis* the wings of the males measure 96.4 as against 85.8 in the females. The contour feathers of *infuscatus* have a more compact appearance than those of *dorsalis* which are more "hairy" in texture. Other differences of color and details of pattern exist but may not be so significant as those I have mentioned. In any case the evidence clearly points to the specific distinction of the two groups.

SPECIMENS EXAMINED

A. dorsalis.—COLOMBIA: La Morelia, 1 ♂, 1 ♀; Florencia, 1 ♀. ECUADOR: Zamora, 2 ♂; Río Suno, above Avila, 2 ♀; below San José, 1 ♀; mouth of Río Curaray, 1 ♂; Zuna, Río Upano, 1 [♀]. PERÚ: Río Seco, west of Moyobamba, 3 ♂, 2 ♀.

Automolus rubiginosus watkinsi Hellmayr

Automolus watkinsi HELLMAYR, 1912 (January 25), Verh. Orn. Ges. Bayern, XI (1), p. 160—Yahuarmayo, Marcapata, Perú; ♀; Munich Mus.

Originally described from a single specimen, the characters of this form have since been substantiated by two additional examples from San Gaban and Chaquimayo in the same region of southeastern Perú.

I have not examined any specimens of this evidently well-marked subspecies, but fortunately Hellmayr's original description is sufficiently detailed to show certain characteristics that now become important for fixing the identity of a specimen from northern Perú.

According to Hellmayr's description, *watkinsi* has a light olive-brown back, with the crown and hind neck sharply defined and chestnut rufous. Since these features are not those of the north-Peruvian bird, the latter may not be referred to *watkinsi*, and since it does not belong to any other known form, it may be described as follows.

Automolus rubiginosus moderatus, new subspecies

TYPE from Río Seco, west of Moyobamba, Perú; altitude 3000 feet. No. 234,721, American Museum of Natural History. Adult male with enlarged gonads, collected July 17, 1925, by Harry Watkins; original No. 9422.

DIAGNOSIS.—Similar to *A. r. watkinsi* as described, but crown and hind neck like the back, only faintly tinged with a warmer tone, and rather sharply defined from the supra-auricular region which is strongly rufescent; back Prout's Brown instead of light Olive Brown.

RANGE.—Northern Perú, south of the lower Marañón, between the Huallaga and the upper Marañón.

DESCRIPTION OF TYPE.—Back Prout's Brown, exactly as in some examples of *A. r. nigricauda*; top of head very slightly warmer in tone, not at all sharply defined from the mantle; rump also very slightly warmer but upper tail coverts decidedly more rufescent, bright Chestnut. Lores dull buffy, with dusky tips; auriculars dull,

dark grayish brown; subocular space from base of auriculars to base of bill dull brownish, with dusky tips and a slightly rufescent tinge; supra-auricular area dark Chestnut in contrast to the color of the back of the head; this rufescence continued on the sides of the neck behind the auriculars and forward beneath them, meeting the brown of the subocular space in a definite line; thence extended across the lower throat in a much paler tint, near warm Hazel; anterior throat becoming gradually paler; chin Cinnamon \times Ochraceous-Buff, with dusky tips. Breast rather definitely separated from the throat and much more olive, light Dresden Brown, darker on the sides; belly paler, more buffy; flanks darker, near Sepia; under tail-coverts more rufescent, near Auburn. Outer surface of wings Chestnut-Brown; under wing-coverts Cinnamon-Rufous; inner margins of remiges Snuff Brown. Tail dark Chestnut. Maxilla (in dried skin) dark horn-brown; mandible dull yellowish on lower margin, becoming like the maxilla along the tomia; feet blackish, with a reddish-brown tone. Wing, 88 mm.; tail, 73.5; exposed culmen, 22; culmen from base, 26.5; tarsus, 28.

REMARKS.—This bird is a definite link between the *rubiginosus* group and *nigricauda*. Compared with *nigricauda*, the upper surface is markedly similar. The back is the very same color, though the upper tail-coverts and tail are brighter rufous. The top of the head, on the other hand, is less rufescent and near the color of *cinnamomeigula*. The abdominal color is between the tones of *cinnamomeigula* and *nigricauda*, but the throat is paler than in either. The east-Ecuadorian form, *brunnescens*, is a much more rufescent bird, a deeply colored *cinnamomeigula* with the same tinge of Bay in the throat.

SPECIMENS EXAMINED

A. r. rubiginosus.—MEXICO: Jalapa, 1 ♂.

A. r. verae-pacis.—GUATEMALA: Finca Sepacuite, 4 ♂, 1 ♀; La Perla, 1 ♂.

A. r. saturatus.—COLOMBIA: Alto Bonito, 3 ♂ (incl. type), 1 (?).

A. r. rufipectus.—COLOMBIA: Chirua, Sta. Marta Mts., 1 ♂.

A. r. cinnamomeigula. COLOMBIA: La Morolia, 1 ♂, 2 ♀.

A. r. brunnescens. ECUADOR: Río Suno, above Avila, 2 ♂; lower Río Suno, 2 ♂; below San José, 2 ♀; mouth of Río Curaray, 1 ♂, 1 ♀.

A. r. nigricauda. ECUADOR: Río de Oro, 1 ♂; Bucay, 1 ♀; Santa Rosa, 1 ♂.

A. r. moderatus. PERÚ: Río Seco, west of Moyobamba, 1 ♂ (type).

Automolus ochrolaemus ochrolaemus (Tschudi)

Anabates ochrolaemus TSCHUDI, 1844 (May), Arch. Naturg., X (1), p. 295—Perú [=forest region, 10°-12° S. lat. (Tschudi, 'Fauna Peruana')=Junín region]; Mus. Neuchâtel.

This is the common form over most of Perú and I have specimens from various localities ranging from Pomará, just west of the middle Marañón, to the southeastern valleys in the Amazonian drainage. A single male from the Río Espíritu Santo, northern Bolivia, is darker above than most of the Peruvian birds, but a Pomará specimen is even

darker, though not so richly colored; on the under surface, the Pomará bird is at the maximum of color. A male from Santa Rosa, on the Upper Ucayali, is very like the Pomará skin, and there are intermediates connecting these and the paler extremes.

Farther east on the north bank of the Amazon, near the Río Napo, *ochrolaemus* is replaced by the following form.

Records of *ochrolaemus* from Perú are from Moyobamba, "Hual-laga" (=between Valle and Yurimaguas?), "Upper Ucayali" (=Cashiboya?), Monterico, San Gaban, and Chaquimayo.

***Automolus ochrolaemus turdinus* (Pelzelin)**

Anabates turdinus PELZELN, 1859, Sitzungsab. Akad. Wiss. Wien, math.-naturw. Kl., XXXIV, pp. 110, 131—part, Barra do Rio Negro (=Manaos), Brazil (Manaos desig. by Hellmayr, 1925); Vienna Mus.

Automolus turdinus macconnelli CHUBB, 1919, Bull. Brit. Orn. Club, XXXIX, p. 60—Ituribisci, British Guiana; British Mus.

A male from Puerto Indiana and a subadult female from Anayacu are the first specimens of this subspecies to be found in Perú. The form occurs, however, in adjacent parts of eastern Ecuador, on the Río Napo, and is not unexpected in Perú.

From this region, *turdinus* ranges northeastward and eastward, and is found in Amazonian Colombia, the vicinity of Mt. Duida and the upper Orinoco in Venezuela, the three Guianas, and the region north of the Amazon in Brazil, from Manaos to Obidos. There appear to be no records from the regions connecting these four areas and it is uncertain just how the continuity is effected, if it is, indeed, existent. Our extensive series of birds from the course of the Rio Negro between Manaos and the Cassiquiare contain no examples of this species, nor are there any from the lower Orinoco. Further collecting is needed to show a connection or establish a hiatus.

Specimens of this group from the south bank of the Amazon east of the Jurua, and eastward to across the Tapajoz, are somewhat different from *turdinus* though not in the direction of *ochrolaemus*. They may be known as follows.

***Automolus ochrolaemus auricularis*, new subspecies**

TYPE from Caxiricatuba, Rio Tapajoz (right bank), Brazil. No. 286,789, American Museum of Natural History. Adult male collected May 15, 1931, by Alfonso M. Olalla.

DIAGNOSIS.—Similar to *A. o. turdinus* of Manaos and adjacent regions north of the Amazon, but under parts paler, without much noticeable dusky margin of the feathers of the center of the breast; under tail-coverts duller, less pronouncedly

rufous; wing-lining averaging very slightly paler; auriculars and subocular space more uniformly deep ochraceous, with some darker brown edges apparent but without the heavy, dusky margins of *turdinus*. Differs from typical *ochrolaemus* of eastern Perú by the much paler coloration of the under parts, though the sides of the head are much the same; upper parts less warmly colored, on average.

RANGE. South bank of the Amazon in Brazil from the right bank of the Tapajoz west at least to Tefé (no records from the left bank of the Madeira.)

DESCRIPTION OF TYPE.—Upper parts dark Saccardo's Umber or light Sepia, becoming Sanford's Brown on the lower rump and upper tail-coverts. Lores buffy, with dusky tips; above the eye a noticeable stripe of deep ochraceous, continued narrowly above the lores and obsoletely over the auriculars; auriculars deep Clay Color, a little brownish at the tips; malar region a little brighter and clearer; chin Pinkish Buff, deepening into Cinnamon-Buff on the throat; breast dull Pinkish Buff, with margins very indistinctly duller; sides darker, inclined to grayish Buffy Brown; abdomen dull Pinkish Buff; flanks like sides, deepening posteriorly into Saccardo's Umber; under tail-coverts dull Sayal Brown. Outer surface of wings Bister \times Sepia; inner webs of remiges fuscous, with inner margins light cinnamonaceous; under wing-coverts Ochraceous-Buff \times Cinnamon; tail light Auburn. Maxilla (in dried skin) dull yellowish brown; mandible dull yellow; feet dark brown. Wing, 92.5 mm.; tail, 73; exposed culmen, 18.5; culmen from base, 23.25; tarsus, 22.

REMARKS.—The dark margins of the pectoral feathers in *A. o. turdinus* are not very pronounced at best, but in the present form they are even less noticeable, and the whole under side has a clear, pinkish buff color that is hardly clouded in the midline, though darkest laterally. Occasional examples of *auricularis* have the under tail-coverts more strongly tinged with rufescence than the type (which is of average coloration), but in such cases the change of color is likewise noticeable on the auriculars where it increases the already ponderable difference between this form and *turdinus*.

Examples from west of the type locality show a tendency toward *ochrolaemus*, increasing somewhat as the range of the latter form is approached. Even at Tefé, however, the birds appear to be closer to *auricularis* than to *ochrolaemus*.

***Automolus ochrolaemus hypophaeus* Ridgway**

Automolus cervinularis hypophaeus RIDGWAY, 1909, Proc. Biol. Soc. Wash., XXII, p. 72 Río Reventazon at Guayabo Station, Costa Rica.

Among the material examined for comparison are a number of specimens from western Panamá which apparently belong to this Costa Rican form, including six from Santa Fé, Veraguas. The very different *A. o. exsertus* was described from Divala, Chiriqui, and, according to material at hand, ranges westward through southern Costa Rica, but seems not to extend very far into Panamá. The specimens from Santa

Fé, though from the Pacific side of the hills, are indistinguishable from Almirante and Río Calovénora skins, and all are notably dark examples of *hypophaeus* without any suggestion of the characters of *exsertus*.

On the other hand a male bird from Río Chiman, eastern Panamá, where typical *pallidigularis* might be expected to occur, is not perfectly typical of that form but shows a dark upper surface suggesting *hypophaeus*. More material from this area is desirable.

SPECIMENS EXAMINED

A. o. ochrolaemus.—PERÚ: Pomará, 1 ♀; Río Negro, west of Moyobamba, 1 ♂, 1 ♀; Santa Rosa, Río Ucayali, 1 ♂; La Merced, 1 ♂, 1 ♀; Tulumayo, 2 ♂, 1 ♀; La Pampa, 1 ♂; Río Tavera, 3 ♀; Astillero, 1 ♀; Pachisa, 1 ♀. BOLIVIA: Río Espíritu Santo, mouth of Río San Antonio, 1 ♂.

A. o. turdinus.—PERÚ: Puerto Indiana, 1 ♂; Anayacu, 1 ♀. ECUADOR: mouth of Río Curaray, 2 ♂, 1 ♀; below San José, 2 ♂, 2 ♀; Río Suno, above Avila, 3 ♀. COLOMBIA: Villavicencio, 1 ♀; Buena Vista, above Villavicencio, 3 ♀; "Bogotá," 1 (?). VENEZUELA: Río Cassiquiare, El Mercey, 1 ♀; (vicinity of Mt. Duida), 9 ♂, 15 ♀. BRITISH GUIANA: Potaro Landing, 2 ♂; Rockstone, 1 ♀; Bonasica, 1 (?); (no locality) 1 (?). BRAZIL: Manaos, Campos Salles, 1 ♂, 1 ♀; Hacienda Río Negro, 2 ♂; Faro (Castanhal, San José, Serra do Espelho, Huaracaná, and mouth of Río Paratucú), 9 ♂, 6 ♀.

A. o. auricularis.—BRAZIL: Río Tapajoz, Caxiricatuba, 1 ♂ (type); Igarapé Brabo, 3 ♂, 2 ♀, 1 (?); Limon, 3 ♂, 2 ♀; Tauary, 1 ♂; Igarapé Amorin, 1 (?); Villa Braga, 1 ♂; Río Amazonas, Villa Bella Imperatriz, Serra de Parintins, 1 ♂, 2 ♀; Río Madeira, Igarapé Auará, 3 ♂, 1 ♀; Borba, 1 ♂, 2 ♀; Teffé, Boca Lago, 1 ♂; Santo Isidoro, 1 ♂.

A. o. pallidigularis.—PANAMÁ: (Lion Hill), 1 ♂ (type); Chepigana, 1 ♂, 1 ♀; El Real, Río Tuyra, 1 ♂; Cituro, 4 ♂, 1 (?); Tacarcuna, 3 ♂, 2 ♀; Tapulisa, 1 ♂, 1 ♀; Río Chiman, 1 ♂; Barro Colorado Island, 1 ♂. COLOMBIA: Honda, 1 ♂; Puerto Valdivia, 2 ♀; Malena, 1 ♂, 1 ♀. ECUADOR: Esmeraldas, 1 ♀, 1 (?); Río de Oro, 2 ♂, 3 ♀.

A. o. hypophaeus.—PANAMÁ: Almirante, 2 ♂, 3 ♀; Río Calovénora, 1 ♀; Santa Fé, Veraguas, 3 ♂, 3 ♀. COSTA RICA: Bonilla, 1 ♂, 1 ♀; Atalanta, 1 ♂, 1 ♀; Aquinares, 1 ♂, 1 ♀; Hacienda La Iberia, 1 ♂; Guacimo, 1 ♂.

A. o. exsertus.—COSTA RICA: Boruca, 1 ♂, 1 ♀; Pozo del Río Grande, 2 ♀; Puerto Jimenez, 1 ♀.

A. o. cervinigularis.—NICARAGUA: Matagalpa, 1 ♂, 2 ♀; Los Sabalos, 1 ♂; Las Cañas, 1 ♀; Savala, 1 ♀; Tuma, 1 ♀; Río Tuma, 1 ♂; Peña Blanca, 1 ♂; Río Grande, 1 ♀; Chontales, 1 ♂; Ocotal, 1 ♀. GUATEMALA: Secanquim, 3 ♂, 3 ♀; San Lucas, 1 (?); Puebla, 1 (?); Chipoc, 1 (?); (no locality), 3 (?).

Automolus rufipileatus consobrinus (Sclater)

Philydor consobrinus SCLATER, 1870, P. Z. S. London, p. 328—"Nova Granada int."—"Bogotá" (Villavicencio suggested by Chapman, 1917); British Mus.

Philydor rufipileatus maynani HELLMAYER, 1903, Verh. Zool. Bot. Ges. Wien, LIII, p. 220—Maynas, Perú; Vienna Mus.

I am uncertain about the distinction of *maynanus* and *consobrinus*. Birds from Perú, south of the Amazon, are consistently bright ochraceous below, while Colombian skins at hand have a slightly browner or more olivaceous tinge on the breast. Ecuadorian skins and some from southwestern Venezuela are a little paler on the under parts, but one from Venezuela is not distinguishable from central Peruvian birds. Bolivian examples for the most part are like the east-Peruvian though one or two show paler tints below. Other minor variations occur throughout the series, involving the color of the back and the top of the head and the size; Bolivian and central Peruvian birds average a little larger than skins from north of the Amazon. With more material from the type locality of *consobrinus* the distinction of *maynanus* may become more apparent, but at the moment I am unable to find sufficient difference to warrant this recognition.

Peruvian records are from Maynas, Moyabamba, and Pebas.

SPECIMENS EXAMINED

A. r. rufipileatus. BRAZIL: Rio Tocantins, Baião, 6 ♂, 3 ♀.

A. r. consobrinus.--COLOMBIA: Villavicencio, 4 ♀. ECUADOR: mouth of Río Curaray, 2 ♂; mouth of Lagarto Cocha, 1 ♂. PERÚ: Puerto Indiana, 1 ♀; Puerto Melendez, 1 ♀; Río Ucayali, Santa Rosa, 6 ♂, 1 ♀; Lagarto, 1 ♂, 1 ♀; mouth of Río Urubamba, 1 ♂. BOLIVIA: Todos Santos, 1 ♂, 1 ♀; mouth of Río San Antonio, 1 ♀; Mission San Antonio, 3 ♂, 1 ♀. VENEZUELA: Mt. Duida, Esmeralda, 2 ♂; Caño León, 2 ♂, 1 ♀; Río Cassiquiare, El Mercey, 1 ♂; opposite El Mercey, 1 ♀; Río Orinoco, opposite mouth of Río Ocamo, 1 ♂, 1 ♀.

Automolus ruficollis ruficollis (Taczanowski)

Anabazenops ruficollis TACZANOWSKI, 1884, 'Orn. Pérou,' II, p. 160—Paucal, Perú; Warsaw Mus.

I agree with Chapman that *ruficollis* is subspecifically distinct from *celicae* of southwestern Ecuador. Ten specimens of the latter, including the type, are noticeably brighter in general coloration than twelve skins from Taulis, Seques, and Chugur; the Taulis and Seques birds are virtual topotypes of *ruficollis*. Other differences which distinguish *celicae* include broader and less prominently marginal pectoral stripes, often whiter and less strongly dusky-margined auriculars, more rufescent crown, deeper ochraceous supra-loral line, paler wings and tail, and brighter rufous crissum.

Six skins from Palambla and one from nearby El Tambo are equivocal. The average is lighter than typical *ruficollis* although some are a perfect match and though the lighter ones approach the paleness of *celicae* they lack the warmth of color characteristic of that form. The

pectoral streaks are rather definite in shape and the lateral under parts rather more olive-tinged than in *celicae*. On the whole, therefore, I believe they are best associated with typical *ruficollis* although their relationship to *celicae* is evident.

I am unable to determine any very close relatives of this group although I believe that the *ochrolaemus* group is the nearest ally.

SPECIMENS EXAMINED

A. r. ruficollis.—PERÚ: Taulis, 1 ♂, 4 ♀, 1 (?); Seques, 3 ♂; Chugur, 2 ♂, 1 ♀; El Tambo, 1 ♂; Palambra, 3 ♂, 3 ♀.

A. r. celicae.—ECUADOR: Celica, 3 ♂, 3 ♀; Guachanamá, 1 ♂; Cebollal, 1 ♂; Alamor, 1 ♂, 1 ♀.

59.57,51 12 (720.5)

A NEW SPECIES OF *EDESSA* FROM PUERTO RICO
(FAMILY PENTATOMIDAE)BY H. G. BARBER¹

Dr. G. N. Wolcott of the Insular Experiment Station of Puerto Rico, in a recent letter, has requested the proper name to apply to an *Edessa*, as he desires to refer to it in a forthcoming article. As this species is new and has been confused in Puerto Rico with both *Edessa affinis* Dallas and *Edessa vinula* Stål, it seems best to make the name available by a description of the species. It was first reported by Wolcott in 1922, under the name *Edessa affinis* Dallas, as injurious to the tender shoots of the coffee plant. The same author reported it in 1924 under *Edessa* species, taken on coffee at several localities in the island; also on *Solanum torvum* in the mountains north of Yauco.

Edessa paravinula*, new speciesEdessa affinis* WOLCOTT (not Dallas), 1922, Circ. 60, Ins. Exp. Sta., p. 5, Fig. 1.*Edessa affinis* WOLCOTT (not Dallas), 1923, Ann. Rept. Ins. Exp. Sta., p. 46, 1921 1922.*Edessa* sp. ? BARBER, 1923, Amer. Mus. Novitates, No. 75, p. 12.*Edessa* sp. WOLCOTT, 1924, Journal Dept. Agr. Porto Rico, VII, p. 253.

WOLCOTT, G. N., 1933, 'An Economic Entomology of the West Indies,' Fig. 99.

The following parts are pale green intermixed with some yellow: head, pronotum except narrow yellow lateral margins, scutellum, narrow costal margin of corium, and the connexivum. Hemelytra, with the exception of the costal margins, yellow, closely punctate with ferruginous and each provided with a large irregular spot of the same color adjacent to the subcostal nerve; disk behind middle provided with a narrow yellow streak, often bifurcate anteriorly and commonly prolonged posteriorly to the middle of the apical margin. Membrane hyaline. Tergum reddish brown, paler in the center behind the apex of the scutellum. Legs and body beneath yellow-testaceous, the latter faintly mottled with pale green along the sides. Antennae yellow-testaceous with the apical two-thirds of both the fourth and fifth segments lightly embrowned.

Head across eyes one-fourth wider than long, for the most part smooth, obsoletely finely wrinkled on the base of the jugs. Antennae with the second and third segments subequal, fifth segment a little longer than the fourth. Pronotum across humeral angles almost three times as wide as long (6.40 by 2.24 mm.); lateral margins straight;

¹Bureau of Entomology, United States Department of Agriculture.

the edge neither impressed nor carinate; humerus gently rounded at apex, projected outwardly slightly beyond the costal margin and forming a right angle with the lateral margin of the pronotum; surface sparsely punctate with ferruginous; lateral margins and the anterior disk including the cicatrices impunctate; anterior submargin before each cicatrix slightly impressed and provided with a few small punctures. Scutellum nearly one-third longer than wide (5.12 by 3.60 mm.); frena reaching halfway; apical half gradually acuminate, apex mucronate; disk very sparsely, toward lateral

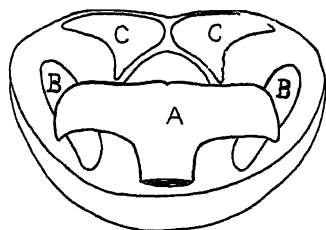


Fig. 1. A, proctiger; B, claspers; C, genital plates.

margins more profusely punctate with ferruginous, apical portion impunctate. Membrane well extended beyond the acute apical angles of the seventh abdominal segment. Metasternal plate with the two anterior arms slightly divaricate, short, extended anteriorly well beyond the middle point of the mesosternum, neither compressed nor carinate below, apices bluntly rounded. Venter impunctate. In the male the apical angles of the seventh abdominal segment are acutely attenuated, extended well beyond the apical margin of the hypopygium, which seen from below is deeply, concavely sinuate in

the middle; posterior margins of hypopygium on either side of the sinus about as broad as the width of the sinus, with the outer angles rounded. In a caudad view the proctiger within the genital cup is broadly T-shaped with the horizontal arms much longer than the cylindrical vertical stem (see Fig. 1); each arm outwardly slightly projected downward in a narrowly rounded, subacute process. In the female, viewed ventrally, the acutely spinose apical angles of the seventh abdominal segment do not extend posteriorly quite so far as the acute apical angles of the eighth segment; the two basal plates or valvifers of the eighth segment are much narrowed within where they are in contact, becoming expanded or somewhat spatulate outwardly. Length of male 11 mm., humeral width 6.40; female 12 mm., humeral width 7 mm.

Type material is distributed in the various collections as follows:

In the American Museum of Natural History.—Type male, Aibonito, June 1–3, 1915 (Lutz and Mutchler); 1 paratype male with same data as type and 3 from Aibonito, July 14–17, 1914 (Barber); 2 paratype females with same data as type, 1 from Aibonito, July 14–17, 1914 (Barber), 1 from Arecibo, July 30–August 1, 1914 (Barber), 1 from Cayey, May 30–31, 1915 (Lutz and Mutchler), and 1 from Jayuya, January 6, 1915.

In the United States National Museum.—Paratypes Cat. No. 50833 as follows: 3 males from Lares, September 8, 1921 (Wolcott), 1 from Bayamon, at light, August 7, 1932 (Anderson and Lesesne), and 1 from Arecibo, on grapefruit leaf, May 4, 1934 (Mills and Anderson); 1 female from Lares, September 8, 1921 (Wolcott), 1 from Cidra, on potato leaf, February 5, 1932 (Anderson and Mills), 2 from Adjuntas on orange,

February 3, 1932 (Oakley), and 1 from Yauco on wild eggplant, July 12, 1932 (Oakley).

In the Insular Experiment Station.—One paratype male from Lares, August 24, 1922, and 1, October 28, 1921 (Sein and Wolcott); 2 paratype females from Lares, October 24 and 28, 1921 (Sein and Wolcott).

In the author's collection.—Paratype males, 1 from Barranquitas, December, 1930 (Colón), and 1 from Utuado, August 6, 1930 (Danforth); 1 paratype female from Barros, October 1, 1930.

This species belongs to the subgenus *Hypoxys* Amyot et Serville, as defined by Stål, 1872, 'Enum. Hemip.,' II, p. 55. It is very closely related to the Mexican species *E. vinula* Stål as depicted by Distant, 1881, 'Biol. Cent.-Amer.,' Rhynch. I, Tab. ix, fig. 13. A male and a female of Stål's species from Teapa, Mexico, determined by Distant, are in the collection of the National Museum. Although these two species are very similar in appearance the males can be very readily distinguished by the difference in the shape of the proctiger in the genital cup. In *E. vinula* this is nearly cylindrical whereas in *E. paravinula* it is expanded laterally in a broad T-shaped form. In the female the two basal plates or valvifers of the eighth ventral abdominal segment in *E. vinula* are broad where in contact along the inner margins, nearly or quite as broad as their posterior margin, whereas in *E. paravinula* these plates are much narrower within where they are in contact, becoming expanded outwardly. A single male specimen of *paravinula* from Utuado in my collection has the posterior margin of the pronotum and the apex of the scutellum conspicuously orange yellow.

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A REVISED RESTORATION OF THE SKELETON OF
BALUCHITHERIUM, GIGANTIC FOSSIL RHINOCEROS
OF CENTRAL ASIA¹

BY WALTER GRANGER AND WILLIAM K. GREGORY

The present article is designed to supplement our full report (now awaiting publication) upon the *Baluchitherium* material obtained by the Central Asiatic Expedition in 1922 to 1930.

The specimens are from the Hsanda Gol and Houldjin formations of Oligocene age. The drawings are by Mrs. Helen Ziska.

The principal parts of the skeleton (Fig. 1), except the sternebrae, are represented in the collection. There is an enormous range in the size of the adults, the smallest middle metacarpal of the manus measuring 390 mm. (Amer. Mus. No. 21613), the longest, 635 mm. in length. We have grouped our material under four descending grades of size. The middle metacarpal of Grade I is 1.4 times as long as that of Grade IV; it is about 1.3 times that of Grade III and 1.2 times that of Grade II. Consequently these factors have been used (Fig. 2) in enlarging bones of the smaller grades to the probable size of Grade I, which is represented by several gigantic cervical vertebrae and by the third metacarpal. Grade II includes the huge skull, a lower jaw associated with a humerus, radius and middle metacarpal, and several ribs (Amer. Mus. No. 28166). Grade III is represented by the smaller occiput, atlas, axis. Grade IV includes associated manus and pes and various associated vertebrae, ribs, femur, tibia and middle metatarsal.

After repeated revisions our restoration (Fig. 2) represents an animal of the largest grade, seventeen feet, three inches in height, at the shoulder (top of spine at first dorsal vertebra). The height at the shoulder as thus estimated far exceeds that of the tallest hitherto known land mammal. The skull is relatively small; the axis is comparatively long and low but cervicals 4 to 7 are relatively very broad and low as compared with those of recent rhinoceroses.

On the whole, our restoration makes *Baluchitherium* not unlike one of the primitive hornless Oligocene rhinoceroses, except for its titanic size and relatively long radius, long femur, small head, elongate axis and wider mid-cervicals.

¹Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 130.

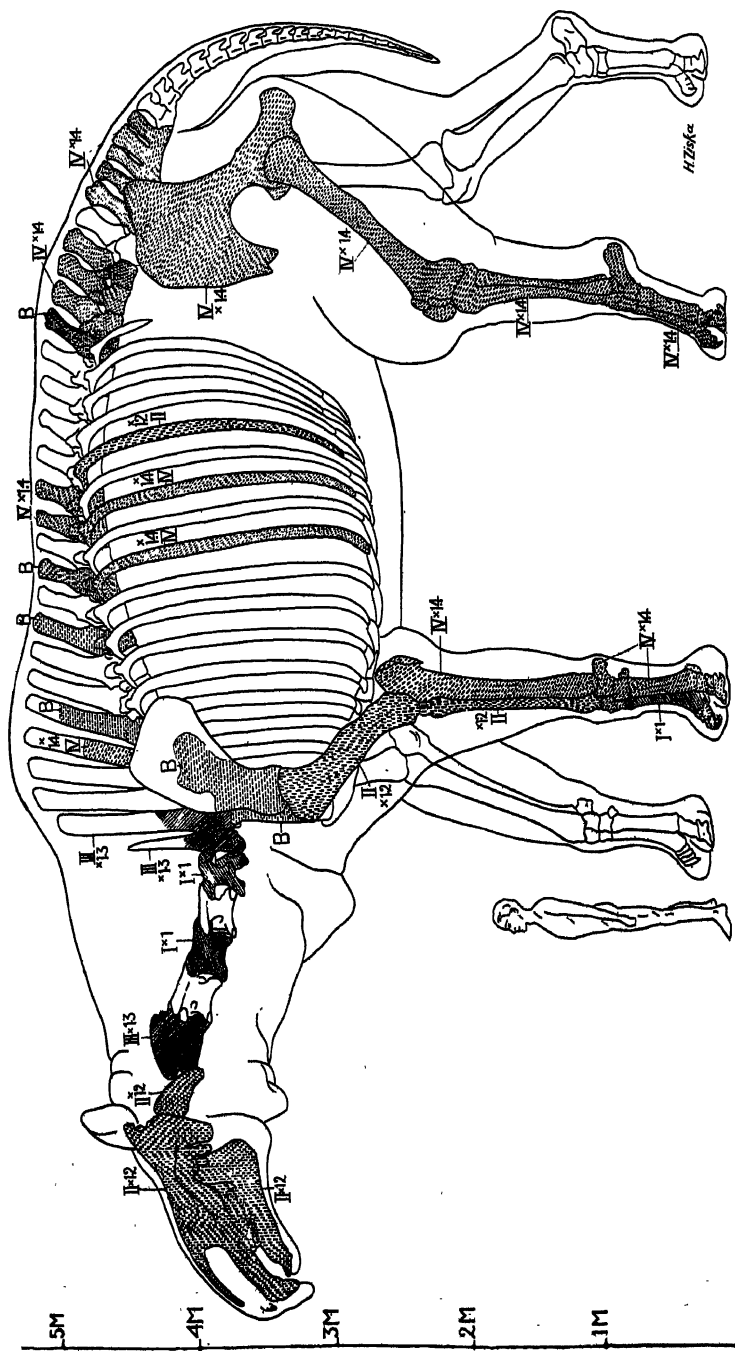


Fig. 1. Restoration of *Baluchitherium*, indicating, by differential shading, the parts belonging to animals of the four grades of size—Grade I being of maximum and Grade IV of minimum size. Bones marked B are from the Borissiak collection.

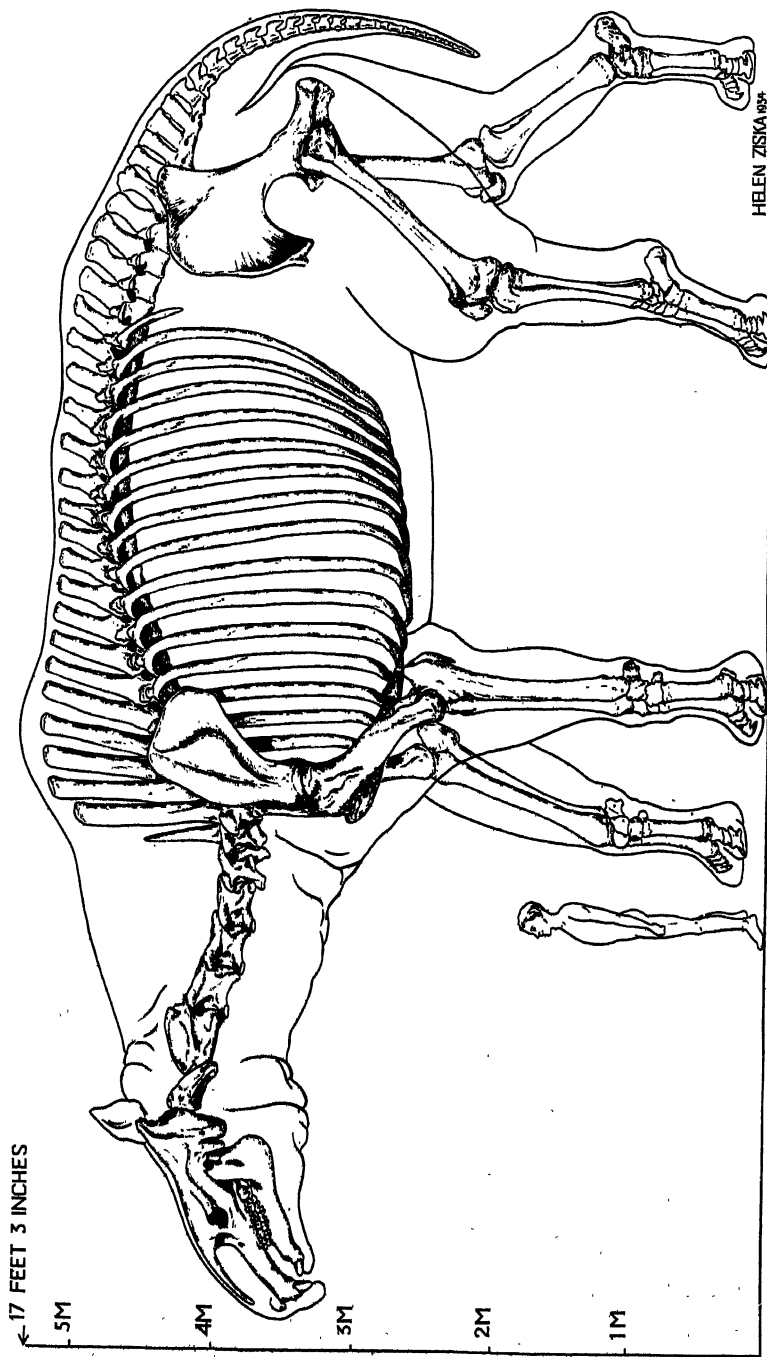


Fig. 2. Restoration of *Baluchitherium*. Based upon all available material and drawn to the size of the largest individual represented in the American Museum collection. A six-foot man is drawn to scale for comparison.

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AFRICAN MUSCIDAE.—III

By C. H. CURRAN

The present contribution includes genera composed almost entirely of metallic blue or green muscids. An effort has been made to bring together all the available information dealing with the groups under discussion and it is hoped that this will lead to the proper recognition of some of the older described species through an examination of the types.

PYRELLIA Desvoidy

DESVOIDY, 1830, Mem. Acad. Roy. Sci. Inst. France, II, p. 462. (Type.—*cadaverina* Linnaeus).

MALLOCH, 1923, Ann. Mag. Nat. Hist., XII, p. 505.

This genus, until 1923, was a composite group to which almost any metallic green muscid was referred, but especially those in which the apical section of the fourth vein was not concave on the outer side. In 1923 Malloch limited the genus to those species having a strong ventral bristle beyond the middle of the middle tibiae, haired pteropleura, bare infra-alar bulla, bare suprasquamal ridge, rather triangular posterior thoracic spiracles, and broad squamae, using, however, only some of these characters, all of which are possessed by the genotype. Most of the species placed in this genus by Stein in his catalogue belong to *Orthellia* Desvoidy.

It is impossible to say how many African species belong here, but the number is not large. For this reason the synonymic catalogue following the remarks on the known species is large and no doubt includes many species belonging elsewhere. Some of these names will possibly replace names proposed more recently, when the types have been examined, as the descriptions published prior to Malloch's characterization of the genus are mostly so poor as to prevent accurate determination.

The following key includes only those species assigned to the genus by Malloch, or known to me.

TABLE OF SPECIES

- | | |
|---|-------------------------------|
| 1.—Eyes bare..... | 3. |
| Eyes pilose..... | 2. |
| 2. —Apex of the abdomen reddish; lower squamal lobe narrow..... | <i>anorufa</i> Villeneuve. |
| Abdomen wholly metallic..... | <i>albocuprea</i> Villeneuve. |

- 3.—Mesonotum with a white median vitta in front. *bonnarius* Curran.
 Mesonotum without anterior pollinose spot 4.
 4.—Anterior spiracle of the thorax brown *nana* Curran.
 Anterior spiracle white *mitis* Curran.

***Pyrellia anorufa* Villeneuve**

VILLENEUVE, 1916, Ann. Soc. Ent. France, p. 147.

MALLOCH, 1925, Ann. Mag. Nat. Hist., XVI, p. 366.

According to Malloch this species, known only from Natal, has the lower squamal lobe narrow. It should probably be placed in a distinct genus.

***Pyrellia albocuprea* Villeneuve**

VILLENEUVE, 1914, Bull. Soc. Ent. France, p. 205.

MALLOCH, 1923, Ann. Mag. Nat. Hist., XII, p. 509.

This species is recorded only from Kenya Colony.

***Pyrellia bonnarius* Curran**

CURRAN, 1928, Bull. Amer. Mus. Nat. Hist., LVII, p. 356.

I have seen only the type specimen from Congo.

***Pyrellia nana* Curran**

CURRAN, 1928, Bull. Amer. Mus. Nat. Hist., LVII, p. 357.

Only the type series, from the Belgian Congo, has been seen by me.

***Pyrellia mitis* Curran**

CURRAN, 1927, Ann. Mag. Nat. Hist., XIX, p. 530.

I have seen no additional specimens of this species. It was described from Transvaal.

CATALOGUE AND SYNONYMY

Pyrellia aethiopis Corti, 1895, Ann. Mus. Genova, XXXV, p. 140 (Abyssinia).

Pyrellia albofasciata Macquart, 1843, 'Dipt. Exot.' II, part 3, p. 119 (Canaries).

This species is probably not a muscid.

Pyrellia arcifrons Stein. See *Orthellia*.

Pyrellia aurantiaca Villeneuve. See *Orthellia*.

Pyrellia bequaerti Villeneuve. See *Orthellia*.

Pyrellia desjardinsii Macquart, 1843, 'Dipt. Exot.' II, part 3, p. 149 (Mauritius).

Pyrellia distincta Villeneuve. See *Orthellia*.

Musca distincta Walker, 1856, 'Dipt. Saunders,' p. 346 (Senegal).

Pyrellia ditissima Villeneuve = *Orthellia splendida* Adams.

Cryptolucilia hirticeps Stein, 1918, Ann. Mus. Nat. Hung., XVI, p. 188 (Natal, Cape). *Orthellia*?

Pyrellia laxifrons Villeneuve, 1916, Ann. Soc. Ent. France, p. 148 (Tanganyika). *Orthellia*?

Pyrellia limbata Villeneuve. See *Orthellia*.

Pyrellia maculisquama Villeneuve, 1916, Ann. Soc. Ent. France, p. 147 (E. Africa). *Orthellia*?

Pseudopyrellia nuda Hough = *Orthellia nudissima* Loew.

Pyrellia nudissima Loew. See *Orthellia*.

Musca obscura Walker, 1856, 'Dipt. Saunders,' p. 346 (Senegal).

Pyrellia orbitalis Stein. See *Orthellia*.

Pyrellia rhingiaeformis Villeneuve. See *Orthellia*.

Pyrellia scintillans Bigot, 1887, Bull. Soc. Zool. France, p. 616 (Cape).

Pyrellia spinthera Bigot, 1878, Ann. Soc. Ent. France, p. 35 (Natal). This species has been identified as an *Orthellia* but the identification is doubtful.

Lucilia spekei Jaenke, 1867, Abh. Senckenb. Gessell., VI, p. 374 (Erytrea).

Pyrellia torpida Walker, 1858, Trans. Ent. Soc. London, IV, p. 214 (Cape).

Pyrellia versatilis Villeneuve. See *Pyrellina*.

Pyrellia viola Bigot, 1878, Ann. Soc. Ent. France, p. 34. (Natal.).

PYRELLINA Malloch

MALLOCH, 1923, Ann. Mag. Nat. Hist., XII, p. 525.

Pyrellina is related to *Pyrellia* Desvoidy, being distinguished by having the first vein setulose dorsally. The infra-alar bulla is bare and the posterior spiracle of the thorax is rather triangular and always moderately large; prosternum and pteropleura haired, the hypopleura below the spiracle and above the posterior coxae with some short, fine hairs. The lower lobe of the squamae is small and strongly narrowed toward the apex.

Up to the present time five African species have been placed in the genus, the type of which is *Lucilia inventrix* Walker.

TABLE OF SPECIES

1.—Femora black.....	2.
Femora and tibiae reddish.....	4.
2.—Abdomen partly yellowish or reddish.....	3.
Abdomen wholly bluish.....	<i>unicolor</i> Malloch.
3.—Abdomen reddish yellow.....	<i>inventrix</i> Walker.
Abdomen blue, the fourth segment partly or wholly reddish.....	<i>ruficauda</i> Malloch.
4.—Second abdominal segment blue; mesonotum densely pale pollinose in front of the suture.....	<i>versatilis</i> Villeneuve.
Second segment yellow basally; mesonotum with a median white spot in front.	<i>rhodesi</i> Malloch.

Pyrellina inventrix Walker

Lucilia inventrix WALKER, 1861, Trans. Ent. Soc. London, V, p. 312.

Ochromyia hemichlora BIGOT, 1877, Ann. Soc. Ent. France, p. 38.

MALLOCH, 1923, Ann. Mag. Nat. Hist., XII, p. 526.

The specimens described by Walker and Bigot came from Natal. I have not seen the species.

***Pyrellina rhodesi* Malloch**

MALLOCH, 1925, Ann. Mag. Nat. Hist., XVI, p. 87.

Described from a single male from Southern Rhodesia.

***Pyrellina ruficauda* Malloch**

MALLOCH, 1923, Ann. Mag. Nat. Hist., XII, p. 526.

Female, Barberton, Transvaal, farm Stentor, June 9, 1925 (H. K. Munro).

This specimen may not be *ruficauda* although it agrees in all respects except for the color of the fourth abdominal segment. This segment is very broadly reddish on its whole length in the middle. Malloch described the fourth segment as reddish with the base more or less violaceous. Malloch described the species from Kenya.

***Pyrellina unicolor* Malloch**

MALLOCH, 1923, Ann. Mag. Nat. Hist., XII, p. 526.

Three males, Du River Camp No. 3, Liberia; male, Gbanga, Liberia, September, 1926; male, Memeh Town, Liberia, August 29, 1926 (J. Bequaert); male, Eden, Cameroon (J. A. Reis).

***Pyrellina versatilis* Villeneuve**

Pyrellia versatilis VILLENEUVE, 1916, Ann. Soc. Ent. France, p. 145.

MALLOCH, 1925, Ann. Mag. Nat. Hist., XVI, p. 367.

Described from Ruwenzori and recorded from there by Malloch. I have seen the following specimens: male, Burunga, Congo; female, Béhungi, Uganda, April 4, 1927 (J. Bequaert).

This species evidently has the thorax variable in color. My specimens have indications of broad, reddish median and lateral vittae on the mesonotum, and when seen from behind with four dark vittae, but these are not conspicuous. The scutellum is brownish yellow with blue reflections and may appear bluish in some lights. The abdomen has the first segment yellow with the broad apex green and bears conspicuous cinereous pollen.

***Orthellia* Desvoidy**

Euphoria DESVOIDY, 1863, 'Hist. Nat. Dipt.,' II, p. 799 (not Burmeister, 1843). (Type.—*cornicina*).

Orthellia DESVOIDY, 1863, 'Hist. Nat. Dipt.,' II, p. 837. (Type.—*cornicina*).

Pseudopyrellia GIESCHNER, 1893, Berl. Ent. Zeitschr., XXXVIII, p. 306 (Type.—*cornicina*).

Pseudogymnosoma TOWNSEND, 1916, Ins. Ins. Mens., IV, p. 150 (Type.—*inflata*).

Pseudorthellia TOWNSEND, 1916, Ins. Ins. Mens., IV, p. 44 (Type.—*Lucilia viridiceps* Macquart).

Orthellia MALLOCH, 1923, Ann Mag. Nat. Hist., XII, p. 505.

Until the discovery by Malloch that the suprasquamal ridge is setulose in the type of this genus, *Musca cornicina* Fabricius, the genus was not properly differentiated from *Pyrellia* Desvoidy, the character used being the course of the fourth wing vein beyond the bend. This is variable even in the genotype and, as a result, Desvoidy based two genera upon the same species. In addition to this character I find that in all but two of the species known to me the infra-alar bulla (a round, knoblike protuberance between the mesopleura and pteropleura) bears short black hairs such as are found in the genus *Panaga* Curran. The two species of *Orthellia* lacking these hairs also have the interfrontal triangle shining black and extending more than halfway to the antennae, so it is possible that they should be removed from the genus. However, some of the species have the bullae haired only posteriorly, so I retain the two species with wholly bare bullae in *Orthellia*.

Several characters in the genus are variable. Many of the species have strong ocellars in the females and in this sex, as well as in some males, there may be at least one strong orbital bristle. One species possesses two or three setulae on the dorsal surface of the median third of the first vein but this is unimportant, as is the extent of the hairing of the third vein; almost all the species have two or three setulae on the origin of the second vein just beyond the humeral cross-vein on the under side. The dorsocentrals, intra-alars, and sternopleurals vary in number and may not be the same in the two sexes. As already indicated the course of the fourth vein is not to be relied upon to too great an extent even for specific purposes, although the vein always ends before the tip of the wing.

The genotype was designated by Coquillett in 1910.

TABLE OF SPECIES

1.—Eyes haired.....	2.
Eyes bare.....	4.
2.—Costal border deep brown.....	2a.
Wings not strongly bicolored.....	3.
2a.—At most two pairs of postsutural dorsocentrals.....	<i>lasiophthalma</i> Malloch.
Four pairs of postsutural dorsocentrals (<i>Pyrellia</i> ?).....	<i>hirticeps</i> Stein.
3.—No presutural dorsocentrals.....	<i>peronii</i> Desvoidy.
Dorsocentrals 2-3.....	<i>bequaerti</i> Villeneuve.
4.—Costal border partly or wholly brown.....	5.
Wings almost unicolorous, the costal border not strikingly darker.....	8.

- 5.—Abdomen reddish.....*aurantiaca* Villeneuve.
 Abdomen green or blue.....6.
- 6.—Costal border brown on the entire length.....7.
 Brown of the costal border interrupted at the apex of the first vein.
bimaculata Stein.
- 7.—Abdomen with coarse, setigerous punctures and with very short hair.
limbata Villeneuve.
 Abdomen with fine punctures and with many erect hairs.....7a.
- 7a.—Mesonotum with a white pollinose median spot in front...*marginipennis* Stein.
 Mesonotum without white pollinose spot.....*intacta*, n. sp.
- 8.—Face strongly produced below, the lower edge of the head longer than the head-height.....*rhingiaeformis* Villeneuve.
 Face normal, the head decidedly higher than long.....9.
- 9.—No well-developed presutural dorsocentrals.....24.
 One or two pairs of well-developed or quite evident presutural dorsocentrals.....10.
- 10.—Only one pair of well-developed presutural dorsocentrals.....11.
 Two pairs of presutural dorsocentrals, both equally strong or nearly so....12.
- 11.—Squamae brown; posterior tibiae with two anteroventral bristles; front of male as wide as third antennal segment, without a series of hairs on the parafrontals.....*pura* Curran.
 Squamae white in female, darkened in male; one anteroventral on the posterior tibiae; front of male twice as wide as third antennal segment; parafrontals with a series of short hairs.....*abnormis* Malloch
- 12.—Halteres black or brown.....13.
 Halteres yellow or reddish.....15.
- 13.—Front of the female shining except on the lowest fifth; lower lobe of squamae in male brown on apical half, without white border.....*boersiana* Bigot.
 Front of female pollinose on almost the lower half; squamae of male with white border.....14.
- 14.—Parafrontals of female thinly pollinose on the upper half, greenish in ground color; middle femora with a strong median bristle in front, terminating the row of short bristles.....*indica* Desvoidy.
 Parafrontals shining violaceous on the upper half; middle femora without a strong median bristle in front.....*scatophaga* Malloch.
- 15.—Mesonotum with three pairs of postsutural dorsocentrals, the anterior two pairs of almost the same length.....16.
 Mesonotum with one to four pairs of postsutural dorsocentrals, the anterior ones very much weaker than the posterior two pairs.....17.
- 16.—Femora violaceous or green.....*nigrocincta* Bigot.
 Femora black.....16a.
- 16a.—Fourth abdominal segment thickly white pollinose from dorsal view.
 analis, n. sp.
 Fourth abdominal segment without evident pollen.....*macrops*, n. sp.
- 17.—Infra-alar bulla with black or yellow hairs.....18.
 Infra-alar bulla bare.....23.
- 18.—Fourth abdominal segment with erect black hairs.....19.
 Fourth segment with only fine, short yellow hair.....*nudissima* Loew.

- 19.—Mesonotum strongly cinereous pollinose in front of the suture, the fourth abdominal segment whitish pollinose. *analis*, n. sp.
 Mesonotum and fourth abdominal segment not conspicuously pollinose. 20.
- 20.—Eyes of male separated by about twice the width of the third antennal segment; female unknown (*Pyrellia*?) *laxifrons* Villeneuve.
 Eyes of male closely approximate or only separated by a distance equal to about the width of the third antennal segment. 21.
- 21.—Eyes of male closely approximated; fourth segment of abdomen not brassy and strongly contrasting with the preceding segment. 22.
 Eyes of male separated by a distance equal to the width of the third antennal segment; abdomen blue with the fourth segment brassy green. *aureopyga* Malloch.
- 22.—Upper facets of the eyes of male strongly enlarged; four pairs of strong postsutural dorsocentrals. (*Pyrellia*?) *arctifrons* Stein.
 Upper facets but little enlarged; anterior two pairs of postsutural dorsocentrals weak. *spinthera* Bigot.
- 23.—First vein with two or three bristles above and below on the median third (*arctifrons* Stein ?) *prima*, n. sp.
 First vein bare except below, just beyond the humeral cross-vein where there are two or three setae (these are present also in *prima*) (*arctifrons* Stein ?). *distincta* Villeneuve.
- 24.—Both sexes with a strong, proclinate orbital bristle on either side. *orbitalis* Stein.
 No proclinate orbitals. 25.
- 25.—Mesonotum and abdomen without erect hairs, the hair quite short and appressed; abdomen reddish yellow. *inflata* Townsend.
 Abdomen with erect hairs or bristles at least on the fourth segment; abdomen metallic. 26.
- 26.—Palpi, face, and antennae reddish. *rubrifacies* Malloch.
 Palpi, face, and antennae blackish or brown. 27.
- 27.—Femora violaceous or greenish at least on the basal half, or the intra-alars absent. 28.
 Femora black; intra-alar long. *vera* Curran.
- 28.—Knob of halteres bright yellow. *prenes*, n. sp.
 Knob of halteres brown, the tip sometimes reddish. 29.
- 29.—Mesonotum with a median whitish patch in front visible from some views. *splendida* Adams.
 Mesonotum unicolorous, not white pollinose anteriorly. *dubia* Malloch.

Orthellia peronii Desvoidy

Lucilia peronii DESVOIDY, 1830, Mem. Acad. Roy. Sci., France, II, p. 460.

Musca cyanea WIEDEMANN, 1830, 'Aussereur. Zwöifl.,' II, p. 397.

Musca sarsina WALKER, 1849, 'List Dipt. Brit. Mus.,' IV, p. 882.

Musca phara WALKER, 1849, 'List Dipt. Brit. Mus.,' IV, p. 889.

Musca mazaca WALKER, 1849, 'List Dipt. Brit. Mus.,' IV, p. 889.

Musca braesia WALKER, 1849, 'List Dipt. Brit. Mus.,' IV, p. 891.

Musca cyanea MALLOCH, 1923, Ann. Mag. Nat. Hist., XII, p. 510.

Male and female, Burunga, Congo (J. Bequaert).

***Orthellia ? hirticeps* Stein**

Cryptolucilia hirticeps STEIN, 1913, Ann. Mus. Nat. Hung., XVI, p. 188.

Described from Natal and Cape Province, South Africa.

There is nothing in Stein's description to indicate the generic position of this species and it may belong to *Pyrellia* Desvoidy. However, several species apparently allied to *hirticeps* properly belong to *Orthellia*, and the probability is that this species also does.

***Orthellia lasiophthalma* Malloch**

MALLOCH, 1928, Ann. Mag. Nat. Hist., I, p. 473.

Described from Kenya Colony.

O. lasiophthalma is evidently closely related to *hirticeps* Stein, having a broad blackish costal border but differing in the bristles on the mesonotum, the postsutural dorsocentrals being reduced to two pairs, whereas there are four in *hirticeps*.

***Orthellia bequaerti* Villeneuve**

Pyrellia bequaerti VILLENEUVE, 1916, Ann. Soc. Ent. France, p. 147.

I have seen one specimen from the Belgian Congo, from whence the species was originally described.

This species is related to the form identified by Malloch as *cyanea* Fabricius, differing in possessing two pairs of presutural dorsocentrals. The eyes are pilose and the wings hyaline.

***Orthellia nudissima* Loew**

Pyrellia nudissima LOEW, 1852, Ber. K. P. Acad. Wiss., Berlin, p. 660 (Mozambique).

Pyrellia nudissima LOEW, 1862, 'Reise Nach Mozamb.', p. 23.

Pseudopyrellia nuda HOUGH, 1898, Proc. Acad. Nat. Sci. Phila., p. 173 (Somaliland).

MALLOCH, 1923, Ann. Mag. Nat. Hist., XII, p. 506.

Eleven males and twelve females, Ienga Town, Liberia, August 15, 1926, on human excrement; two males and two females, Kaka Town, Liberia, August 18, 1926; male and four females, Gbanga, Liberia, September, 1926; male and four females, Reppe's Town, Liberia, September 1, 1926; male and two females, Du River Camp No. 3, Liberia; six females, Memeh Town, Liberia, August 29, 1926; female, Banga, Liberia, October, 1926 (J. Bequaert).

In addition to the specimens recorded above the Museum possesses a paratype of *Pseudopyrellia nuda* Hough from Somaliland.

O. nudissima may be readily distinguished from all the known species, with the exception of *inflata* Townsend, by the absence of erect hairs on the abdomen, and from *inflata* by the presence of two pairs of short but distinct presutural dorsocentral bristles and the rather uniform size of the eye facets.

***Orthellia inflata* Townsend**

Pseudogymnosoma inflata TOWNSEND, 1916, Ins. Ins. Mens., VI, p. 151.

MALLOCH, 1923, Ann. Mag. Nat. Hist., XII, p. 507.

I have not seen this species, described from Angola, but it is very much like *aurantiaca* Villeneuve, differing in having the wings almost unicolorous and in lacking the anterior sternopleural bristle. According to Malloch one male belonging to the type series possesses the characters of *aurantiaca* but evidently has the legs black. Should the two forms prove to be identical, Townsend's name would have priority as his article appeared more than a month before Villeneuve's.

***Orthellia aurantiaca* Villeneuve**

Pyrellia nudissima aurantiaca VILLENEUVE, 1916 (December 8), Ann. South African Mus., XV, p. 512.

I have not seen this species which was described from a single female from Natal.

Judging by the description the specimen from which this species was described is teneral and it is possible that the coloration, at least of the legs, is due to this fact. Among the type series of *inflata* Townsend (Oct. 30, 1916) is a male that agrees with Villeneuve's description except that it has black legs (Malloch, 1923, Ann. Mag. Nat. Hist., XII, p. 507). *O. aurantiaca* apparently possesses an anterior sternopleural bristle, as in *nudissima* Loew, but this is lacking in *inflata* Townsend. *O. bimaculata* Stein has the wings colored as in *aurantiaca* but has the abdomen green.

***Orthellia bimaculata* Stein**

Pyrellia bimaculata STEIN, 1918, Ann. Mus. Nat. Hung., XVI, p. 187.

The single female from which this species was described came from Tanganyika.

The brown costal border is broadly interrupted at the apex of the first vein, thus distinguishing this form from the others with brown costal border and metallic abdomen. The only other described species that has similar wing markings is *aurantiaca* Villeneuve, and I suspect that both names apply to the same species.

***Orthellia limbata* Villeneuve**

Pyrellia nudissima limbata VILLENEUVE, 1916, Ann. South African Mus., XV, p. 512.

Female, Burunga, Congo; four females from Lenga Town, August 15, 1926, and four from Du River Camp No. 3, Liberia (J. Bequaert); three females, Stanleyville, Congo (Lang and Chapin).

This species was originally described as a variety of *nudissima* Loew. It is distinguished by the broadly brown costal border and the absence of white pile on the venter and apical tergite. The specimens from Lenga Town were taken "on human excrement."

***Orthellia marginipennis* Stein**

Cryptolucilia marginipennis STEIN, 1918, Ann. Mus. Nat. Hung., XVI, p. 188. MALLOCH, 1923, Ann. Mag. Nat. Hist., XII, p. 510.

Originally described from Tanganyika and recorded by Malloch from Uganda.

***Orthellia intacta*, new species**

Blue-green, the abdomen rather brassy; wings pale brown with the costal border broadly dark brown; dorsocentrals 2-4. Length, 7 mm.

MALE.—Head black in ground color, the face, posterior orbits, and parafrontals on the lower half, rather thinly cinereous pollinose. Eyes closely approximate; frontals hairlike except below, numerous; ocellars not differentiated; verticals strong. Cheeks about one-fifth as wide as the eye-height, shining black. Parafacials narrow; facial ridges setose on the lower half. Palpi blackish. Antennae brown, the arista with very long rays.

Thorax green; pleura with thin brownish-gray pollen, the mesonotum with thin brown pollen except on the lateral and posterior borders. Dorsocentrals 2-4; acrosticals 0-1; one intra-alar; prealar moderately long, sternopleurals 1-3.

Legs blackish. Middle femora with one or two anteroventral and two posteroventral bristles on the basal half; posterior femora with an entire row of antero-dorsal bristles, a row of five or six anteroventrals and one posteroventral before the middle. Anterior tibia without median bristles; middle tibiae with a row of four or five anterodorsal bristles and a very strong anteroventral; posterior tibiae with a long calcar, a row of short anterodorsals among which is a stronger one, and one anteroventral bristle.

Wings pale brownish, the costal border broadly dark brown, the dark color extending over the anal cell basally and to slightly behind the third vein apically; base of second vein with a setula at its origin; third setulose from the base to the anterior cross-vein on upper and lower surfaces; apical section of fourth vein not concave on outer side. Squamae brownish with the outer edge whitish basally. Halteres with reddish-yellow knob.

Abdomen rather brassy green, the first segment black; fourth segment with erect bristly hairs.

TYPE.—Male, Reppo's Town, Liberia, September, 1926 (J. Bequaert).

***Orthellia pura* Curran**

CURRAN, 1928, Bull. Amer. Mus. Nat. Hist., LVII, p. 358.

Male, Kisenje, Congo, February, 1927; male, Monrovia, Liberia; male, Du River Camp No. 3, Liberia, 1926; male, Memeh Town, Liberia, August 29, 1926; male, Kaka Town, Liberia, August 18, 1926 (J. Bequaert).

***Orthellia abnormis* Malloch**

MALLOCH, 1923, Ann. Mag. Nat. Hist., XII, p. 512.

I have not seen this species, originally described from two specimens from Natal.

***Orthellia boersiana* Bigot**

Somomyia boersiana BIGOT, 1877, Ann. Soc. Ent. France., p. 37.

Somomyia caffra BIGOT, 1877, Ann. Soc. Ent. France, p. 37.

Pyrellia nigrohalterata STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 471.

Orthellia nigrohalterata MALLOCH, 1923, Ann. Mag. Nat. Hist., XII, p. 508.

Male, Nya Ngezi, Congo, February 3, 1927 (J. Bequaert); female, Buea, Cameroon.

Stein described this species from Tanganyika and Malloch recorded it from Natal. Bigot's specimens were from South Africa.

***Orthellia indica* Desvoidy**

Lucilia indica DESVOIDY, Mem. Acad. Roy. Sci. Inst. France, II, p. 453.

Orthellia latifrons MALLOCH, 1923, Ann. Mag. Nat. Hist., XII, p. 508.

Described by Malloch from a single female from Natal. The type is in the Natal Museum.

***Orthellia scatophaga* Malloch**

MALLOCH, 1924, Ann. Mag. Nat. Hist., XIV, p. 519.

Male and female, Prospect, Cape Province, March, 1924 (H. K. Munro); male and female, Transkei, Cape Province (Dr. Jordan).

The two specimens from Prospect are from the same lot as the type series, described by Malloch. I have seen several other specimens bearing the same data as those recorded above.

***Orthellia nigrocincta* Bigot**

Lucilia nigrocincta BIGOT, 1858, in Thomson, 'Arch. Ent.,' II, p. 369.

Pyrellia albigena STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 469.

Pyrellia albigena MALLOCH, 1923, Ann. Mag. Nat. Hist., XII, p. 508.

Female Burunga, Congo (J. Bequaert); two males, three females, Umtali, Southern Rhodesia, April, 1929 (A. Cuthbertson); male, New

Hanover, Natal, August 15, 1913 (Geo. C. Haines); female, Salisbury, Southern Rhodesia, April, 1932 (A. Cuthbertson); male and five females, Lourenco Marques, April-July, 1914; male, Waterfall, Boven, Transvaal, 3800 ft. (H. A. Junod); female, Johannesburg, February, 1905 (?); Stein described the species from Tanganyika, Madagascar and Sokotra.

***Orthellia macrops*, new species**

Green, more or less brassy; dorsocentrals 2-3. Length, 8 mm.

MALE.—Head black in ground color, occiput greenish; cheeks violaceous; face and front rather thinly cinereous pollinose. Eyes almost touching for almost half the length of the front, the facets on the upper half greatly enlarged. Frontals hairlike, about five pairs anteriorly and five or six pairs in front of the ocelli; ocellars not developed. Cheeks one-sixth as wide as the eye-height. Parafacials narrow. Facial ridges setulose on lower half. Palpi brown. Antennae brown, the basal two segments reddish.

Thorax green, the pleura with very thin whitish pollen; mesonotum with brownish-gray pollen except on the broad posterior and lateral margins, best seen from posterior view. Dorsocentrals 2-3, all strong; one intra-alar; pre-alar half as long as the following bristle; acrosticals 0-1; sternopleurals 1-2.

Legs blackish. Middle femora with two anteroventral and one posteroventral bristle on the basal third; posterior femora with three anteroventral bristles on the apical third, one posteroventral before the middle and a row of anterodorsals. Anterior tibiae without median bristles; middle tibiae with a row of posterior bristles and a strong posteroventral; posterior tibiae with a strong calcar, a row of weak anterodorsal bristles ending in a stronger one beyond the middle and an anteroventral bristle beyond the middle.

Wings hyaline; base of second vein with three setulae a little beyond the humeral cross-vein on the under surface; third vein setulose almost to the anterior cross-vein on its upper side and on most of its length on the lower side. Bend of fourth vein rounded. Squamae brown, the base white on the outer part. Halteres missing.

Abdomen brilliant green; fourth segment with erect, bristly hairs.

TYPE.—Male, Lukugo, Congo, December 23, 1926 (J. Bequaert).

***Orthellia analis*, new species**

Thorax violaceous; abdomen blue-green, the fourth segment appearing white from anterodorsal view; three or four pairs of postsutural dorsocentrals, the anterior pair weak or absent; eye facets not enlarged in male. Length, 7.5 to 8.5 mm.

MALE.—Face and front black, cinereous pollinose; occiput and cheeks violaceous, the latter sometimes more blackish, thinly pollinose. Eyes separated by about the width of the third antennal segment, the black frontal vitta narrow; frontals hairlike; parafrontals evidently bare on the upper half; ocellars absent. Cheeks about one-sixth as wide as the eye-height. Palpi blackish. Antennae brown.

Thorax violaceous; pleura obscurely pale pollinose; mesonotum, from posterior view, cinereous-white pollinose except laterally and from dorsal view with three dull whitish spots on the anterior border. Dorsocentrals 2-3 or 4, the posterior three pairs strong; one intra-alar; prealar long; sternopleurals 1-3.

Legs black; middle femora with erect or suberect hair below and a postero-ventral bristle near the middle, a hair on either surface near the base bristlelike; posterior femora with a row of five strong anteroventral bristles on the apical half and two weak ones on the basal third, one posteroventral before the middle and an entire anterodorsal row of bristles. Anterior tibiae without bristles, the middle pair with about five behind and a very strong ventral; posterior tibiae with the calcar, one or two anterodorsal and two or three anteroventral bristles.

Wings cinereous hyaline; apical section of fourth vein not concave on the outer side; third vein with setulae above and below from the base to the anterior cross-vein; origin of second vein with two setulae. Squamae pale brownish, the outer border broadly white basally. Halteres with reddish yellow knobs.

Abdomen blue-green; fourth segment, from anterodorsal view, white except on the narrow base, its hair erect and partly bristle-like.

FEMALE. —Front narrower than either eye; face and lower half of the front cinereous-white pollinose, rather silvery white in some views; parafrontals violaceous above; eight to ten pairs of frontals, the upper pair reclinate; one strong proclinate orbital situated above the middle of the front and several proclinate hairs; ocellars and outer verticals long. Squamae white. Fourth abdominal segment inclined to be violaceous.

TYPES. Holotype, male, allotype, female, and paratype, female, Burunga, Congo (J. Bequaert).

***Orthellia ? laxifrons* Villeneuve**

Pyrellia laxifrons VILLENEUVE, 1916, Ann. Soc. Ent. France, p. 148.

This species, described from Tanganyika, probably belongs to *Orthellia*. The front is described as about twice as wide as the third antennal segment.

***Orthellia aureopyga* Malloch**

MALLOCH, 1923, Ann. Mag. Nat. Hist., XII, p. 510.

Described from Kenya. I have not seen the species.

***Orthellia ? arctifrons* Stein**

Pyrellia arctifrons STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 472.

Described from Tanganyika. The eyes have the facets greatly enlarged on the upper half except posteriorly.

***Orthellia spinthera* Bigot**

Pyrellia spinthera BIGOT, 1878, Ann. Soc. Ent. France, p. 35 (Natal).

MALLOCH, 1923, Ann. Mag. Nat. Hist., XII, p. 513.

Orthellia distincta CURRAN, 1928, Bull. Amer. Mus. Nat. Hist., LVII, p. 358.

Male and six females, Lenga Town, Liberia, August 15, 1926; male and three females, Memeh Town, Liberia, August 29, 1926 (J. Bequaert); male, Stanleyville, Congo, March, 1915 (Lang and Chapin).

In his identification of this species Malloch followed Bezzi, but it is by no means certain that the identification is correct.

***Orthellia orbitalis* Stein**

Pyrellia orbitalis STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 470.

Stein described this species from Tanganyika and in 1928 I recorded a female from Congo.

***Orthellia rubrifacies* Malloch**

MALLOCH, 1923, Ann. Mag. Nat. Hist., XII, p. 511.

Described from Kenya and quite easily recognizable by the reddish palpi, face, and antennae.

***Orthellia vera* Curran**

CURRAN, 1928, Bull. Amer. Mus. Nat. Hist., LVII, p. 358.

This species was described from the Congo and I have seen no additional material.

***Orthellia splendida* Adams**

Paracompsomyia splendida ADAMS, 1904, Kansas Univ. Sci. Bull., III, p. 202.

Pyrellia ditissima VILLENEUVE, 1916, Ann. Soc. Ent. France, p. 146.

MALLOCH, 1923, Ann. Mag. Nat. Hist., XII, p. 513.

Two males and two females Salisbury, Southern Rhodesia (F. L. Snow), cotypes; two males and one female, Salisbury, February and April, 1929 (A. Cuthbertson); male, Djibuti to Addis Abbaba Rail Road, Abyssinia, September 14-17, 1920 (B. Brown); male and female, Balla Balla, Southern Rhodesia, March, April, 1931 (A. Cuthbertson).

***Orthellia dubia* Malloch**

MALLOCH, 1923, Ann. Mag. Nat. Hist., XII, p. 511.

Described from East Africa and Nyassaland.

I have been unable to identify this species in the material before me and am not certain that it is distinct from *splendida* Adams. The only difference is in the absence of a whitish median spot on the front of the mesonotum; and in some specimens of *splendida* this is not at all conspicuous and it is sometimes more grayish, or even brownish gray, than white. Malloch separates the two species also by the number of dorso-centrals, *dubia* having but one pair. In some specimens of *splendida* the anterior pair is so small as to be overlooked and sometimes there is only one on one side and two on the other. Both species have the knob of the halteres brownish although there is a tendency for the knob to be reddish apically in *splendida*.

Orthellia prenes, new species

Evidently related to *splendida* Adams but with two or three pairs of dorsocentrals, bright yellow halteres, narrower frontal vitta, and less extensively pollinose parafrontals. Length, about 9.5 mm.

FEMALE.—Head violaceous, the occiput green behind; face and lowest fourth of the parafrontals black in ground color and densely silvery-white pollinose. Frontal vitta blackish, white pollinose, much narrower than either parafrontal; six or seven pairs of frontals on the anterior half, the shining part of the parafrontals rather thickly haired; ocellars scarcely developed; outer verticals rather weak. Cheeks almost one-fifth as wide as the eye-height, very thinly pollinose, black-haired. Parafacials wide. Oral margin produced. Palpi long, black. Antennae black. The front is broader than either eye.

Thorax violaceous, with green reflections; mesonotum with a broad, obscure cinereous-white stripe in front of the suture which is conspicuous in front. Dorsocentrals 0-2 or 3, only the posterior pair strong; intra-alar strong; prealar half as long as the following bristle; sternopleurals 1-3.

Legs black; femora violaceous; middle femora with a row of fine anteroventral bristles on the basal third and evidently with two or three posteroventrals on the basal fourth; posterior femora with entire rows on the anterodorsal and anteroventral surfaces and a single ventral bristle near the basal third. Anterior tibiae without bristles near the middle, the middle pair with about five posterior bristles and a strong posteroventral near the apical third; posterior tibiae with one (perhaps two) anterodorsal and one anteroventral bristle.

Wing hyaline; outer edge of last section of fourth vein not concave; third vein bristled above and below about halfway to the small cross-vein. Squamae white. Knob of halteres bright yellowish.

Abdomen violaceous with green reflections, or wholly green; fourth segment with erect black hair.

MALE.—Front decidedly wider than the third antennal segment, violaceous on the upper half or more of the orbits, the frontal vitta white from anterior view; frontals all hairlike; occiput violaceous, rather thinly pale pollinose; ocellars and verticals absent.

TYPES.—Holotype, female, Johannesburg, August; allotype, male, Basutoland. Paratypes: male and six females, Johannesburg, July, 1895; four males and three females, Johannesburg, 1899; male, Johannesburg, 1904 (J. P. Cregor); male and two females, Basutoland.

This species is evidently most closely related to *rhingiaeformis* Villeneuve, but the face is much less produced and truncate apically. It forms a connecting link between that species and *splendida* Adams in the shape of the head, and, like both these species, lacks ocellar bristles in both sexes, most of the species lacking them in the male but possessing them in the female. However, this character is by no means a generic one in this case as there is a gradual intergradation.

***Orthellia rhingiaeformis* Villeneuve**

Pyrellia rhingiaeformis VILLENEUVE, 1914, Bull. Soc. Ent. France, p. 204
MALLOCH, 1923, Ann. Mag. Nat. Hist., XII, p. 507.

Two males and seven females, Burunga, Congo (J. Bequaert); numerous specimens from Addis Abbaba, Abyssinia, July and August (B. Brown).

This easily recognized species varies in color from green to violaceous. The strongly produced face, which is not, however, at all like that of *Rhingia* Scopoli, as suggested by the name, is characteristic, and I know of no species approaching it in this regard.

***Orthellia distincta* Villeneuve**

Pyrellia distincta VILLENEUVE, 1916, Ann. Soc. Ent. France, p. 148.

Male and two females from Cameroon. Villeneuve described the species from the Congo.

This species, if I have correctly identified it, is readily distinguished from all others in the genus by the absence of hairs on the infra-alar bullae and non-setulose first wing vein. In the male before me the basal segment of the posterior tarsi lacks the usual row of black bristly setulae on the anteroventral surface and thus agrees with Villeneuve's description. The females possess the row of setulae but may be recognized by the bare bullae. This species may prove to be the same as *arctifrons* Stein.

The absence of hairs on the infra-alar bullae might be considered of sufficient importance for the erection of a genus, but a few species have the hairs limited to the posterior portion and thus form a link with the typical forms in which the bulla is wholly haired.

***Orthellia prima*, new species**

A readily recognized species because of the bare infra-alar bullae and presence of two or three setulae on the upper surface of the median third of the first vein. Length, 6 to 9 mm.

MALE.—Head black; face and lowest fourth of the front silvery-white pollinose, the cheeks and occiput with thin brownish pollen. Eyes almost touching for about one-fourth the length of the front, the frontal hairs extending the whole length, two or three of the anterior pairs developed as bristles; ocellars absent. Cheeks about one-eighth as wide as the eye-height; eyes with enlarged facets in front. Palpi black. Antennae brownish.

Thorax bluish, obscurely pollinose, the mesonotum appearing brown from anterior view except on the broad lateral margins. Dorsocentrals 2-4; anterior intra-alar weak; prealar strong; sternopleurals 1-3.

Legs black; middle femora with a ventral bristle near the middle; posterior femora with a medianly interrupted row of seven or eight anteroventral bristles, a

single posteroventral situated before the middle and an entire row of anterodorsal bristles. Anterior tibiae without median bristles; middle tibiae with five or six posterior bristles and a strong posteroventral; posterior tibiae with the calcar, a row of four or five short anterodorsal bristles ending in a longer one near the middle and two anteroventral bristles. Posterior tarsi with a row of short, black setulae on the anteroventral surface.

Wings cinereous hyaline; bend of fourth vein broadly rounded; base of second vein ventrally with three setulae at its origin; first vein dorsally with two or three setulae on the median third; third vein setulose above and below between the base and the anterior cross-vein. Squamae brownish, broadly white on the outer portion basally. Halteres reddish yellow.

Abdomen bright green; fourth segment with subappressed hair and several erect hairs toward either side.

FEMALE.—Mesonotum usually rather violaceous, the abdomen often bluish. Parafrontals shining black except on the anterior fifth; ten pairs of frontals, the upper pair reclinate; frontal triangle shining black, reaching to beyond the middle of the front; ocellars and outer verticals strong. Three intra-alar bristles.

TYPES.—Holotype, male, Memeh Town, Liberia, August 29, 1926; allotype, female, Reppe's Town, Liberia, September 1, 1926. Paratypes: three females, Reppe's Town, September 1, 1926; female, Memeh Town, August 29, 1926; and nine females, Lenga Town, Liberia, August 15, 1926; (J. Bequaert).

CATALOGUE AND SYNONYMY

albigena Stein = *nigrocincta* Bigot.

? (*Lucilia*) *barthii* Jaenicke, 1866, 'Neue Exot. Dipt.,' p. 374 (Erytrea).

braesia Walker = *peronii* Desvoidy.

cyanca Malloch (not Fabricius) = *peronii* Desvoidy.

? (*Cosmina*) *diademata* Bigot, 1877, Ann. Soc. Ent. France, p. 37 (Cape).

ditissima Villeneuve = *splendida* Adams.

latifrons Malloch = *indica* Desvoidy.

mazaca Walker = *peronii* Desvoidy.

nuda Hough = *nudissima* Loew.

phara Walker = *peronii* Desvoidy.

(*Musca*) *racilia* Walker, 1819, 'List. Dipt. Brit. Mus.,' IV, p. 884 (Sierra Leone).

sarsina Walker = *peronii* Desvoidy.

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TWO NEW GENERA OF CRICETID RODENTS FROM THE MIOCENE OF WESTERN UNITED STATES

BY ALBERT ELMER WOOD

In the course of preliminary studies on fossil Cricetidae, the author has discovered two specimens that belong to this family, and whose characters warrant their separation, as distinct genera, from the previously known forms. For permission to study the first of these, I am greatly indebted to Dr. Walter Granger. The second, from the author's private collection, is now presented to the American Museum. This study was made while I was Cutting Traveling Fellow in Columbia University. The illustrations are by the author.

Other than their allocation to the family Cricetidae, the relationships of these two forms are not discussed, that being reserved for a later date, after more is known of the Oligocene forms generally referred to *Eumys*.

Schaubeumys grangeri, new genus and species¹

Figure 1

HOLOTYPE. A. M. N. H. No. 13757, lower jaws with associated upper molar and fragments of skull.



Fig. 1. *Schaubeumys grangeri*, n.g., n. sp. Type, A.M.N.H. No. 13757. A. Right lower molars, $\times 10$. B. Left second upper molar, $\times 10$.

The teeth are drawn with the buccal side at the top and with the anterior end to the left.

HORIZON AND LOCALITY. Lower Roschud, Potato Creek, Pine Ridge Indian Reservation, South Dakota. Collected by Albert Thomson in 1906.

DIAGNOSIS. Similar in general aspect to *Eumys*, but the central crest is lacking in lower molars except on M_1 , where it is greatly elongate, reaching the lingual side

¹I take great pleasure in naming this genus after Dr. Samuel Schaub, the foremost worker on fossil rodents. The specific name is given in appreciation of Dr. Walter Granger's kindness in opening the rodent collections of the American Museum to me.

of the tooth; M_1 developing transverse crests, other molars tending toward alternation of external and internal cusps.

This species, although in general similar to the Oligocene form, shows several very distinct advances. In M_1 , the protoconid and metaconid have united to form a transverse crest, and have lost all their former connections with the anteroconid (cusp of the anterior cingulum), which appears to have been secondarily reduced and to have lost its crescent arms. The central crest of this tooth has increased greatly in size, and extends to the lingual margin of the tooth, paralleling the metalophid and hypolophid, not only in direction, but also in size. The buccal end of this crest is a strong, well-rounded cusp (called by Schaub¹ the "Mesostylidsporn" or mesostylid spur). In the other two lower molars, there is a strong cusp forming the center of the anterior cingulum, which unites with the metaconid. Its union with the protoconid is aborted in M_2 and weak in M_3 . No trace of central crests appears in either of these teeth. The posterior crescent arm of the protoconid of M_2 is reduced, and is breaking up into a series of conules, which suggests that it is in the process of disappearing. In the upper molar (M^2 , Fig. 1B), the anterior cingulum is reduced to a single cusp at the center of the tooth, connected by a crest with the protocone. From this crest another cusp has budded off. The central crest is well developed. The posterior cingulum is minute.

The characters listed above seem, on the whole, to be specializations of the *Eumys* type of tooth toward what is found in *Peromyscus*. Unfortunately, we do not know the Oligocene forms well enough to be able to tell, as yet, from which, if any, of the many forms lumped under "*Eumys elegans*" this animal has been derived. Nor is it possible as yet to indicate its precise relationships with *Peromyscus*. However, the fact that the posterior arm of the protoconid of M_2 is disintegrating, instead of swinging posterad to meet the entoconid, as seems to have happened in the ancestors of *Peromyscus*, would seem to indicate that this is a member of another line.

***Horatiomys montanus*, new genus and species²**

Figure 2

HOLOTYPE.—A. M. N. H. No. 22714, right mandible with M_1 .

HORIZON AND LOCALITY.—Deep River Miocene, seven miles south of Ft. Logan, Montana, west side of Smith River, north side of Thompson's Gulch, west of main road. Collected by A. E. Wood, August 30, 1931.

¹Schaub, S. 1925. 'Die Hamsterartigen Nagetiere des Tertiärs und ihre lebenden Verwandten.' Abh. Schweiz. Pal. Gesell., XLV, 112 pp., 5 pls., 15 figs.

²I take great pleasure in naming this genus after Dr. Horace Elmer Wood, II, in appreciation of his invaluable assistance to me in my work on fossil rodents.

DIAGNOSIS.—Pattern based on four main cusps with a two-cusped anterior cingulum; posterior cingulum vestigial; large central cusp with three radiating arms; crest running posterad from metaconid along lingual margin of the tooth.

Besides the arrangement of the cusps as outlined in the diagnosis, and as may be seen from the figure, the outstanding features of this tooth are the extreme elevation of the four primary cusps, and the fact that the union between the hypoconid and the entoconid is at the posterior margin of these two cusps, instead of at the anterior end, as in *Schaubermys*. The manner in which this different type of loph formation has

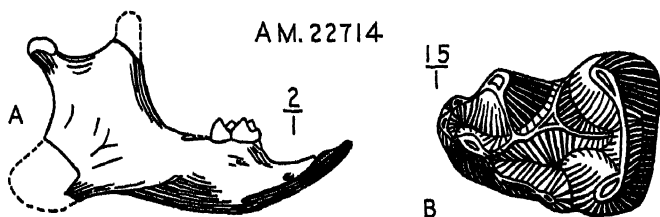


Fig. 2. *Horationmys montanus*, n.g., n. sp. Type, A.M.N.H. No. 22714. A. Right mandible, outer view, $\times 2$. B. Right first lower molar, $\times 15$.

The buccal side of the enlarged molar is at the top; the anterior end to the left.

arisen can not be determined from the available material. The jaw itself has some peculiarities in shape, particularly noticeable in the quadrangular ascending portion. The masseteric crest ends well back, below the center of the alveolus of M_2 , and is widely separated from the mental foramen.

The relationships of this animal are entirely unknown at the present moment. There are certain vague similarities in pattern between M_1 and the corresponding tooth of *Neotoma*, but they are too sketchy, and the time interval is too great, to allow any trust to be put in them. The phylogenetic position of this form cannot be determined until after further study of middle Tertiary Cricetidae.

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TAXONOMIC NOTES CONCERNING ARVICANTHINE RODENTS¹

BY ROBERT T. HATT

Study of the American Museum collections of African rodents has indicated the desirability of clarifying the nomenclatorial status of three forms of the genus *Pelomys* reported from the Kasai district of the Belgian Congo, and also of the naming of a new form of the striped grass-rat, *Lemniscomys*, occurring in the savannas of the upper Uele. These matters are here given attention preparatory to the completion of a full report on the rodents of the Congo represented in the collections obtained by the American Museum Congo Expedition.

LEMNISCOMYS

Specimens of the *Lemniscomys barbarus* group, obtained by the Congo Expedition at Faradje, may be sorted into what appear to me to be three natural groups whose principal diagnostic features compare as follows:

	A	B	C
Head-body length (approximate)	90	100	80
Tail length (approximate)	130	130	115
Foot length	25	25	23
Greatest skull length	27.5	27.2	26.7
Length upper molar row	4.8	5.1	4.6
Width M ¹	1.6	1.8	1.6
General color	dark	pallid	dark
Facial stripes	present	absent	present
Pelage	hispid	very hispid	hispid
Number of adult specimens	15	2	3

The smallest of these three ("C") corresponds rather closely in its status as a distinct taxonomic unit to the smaller form of the *striatus* group (*akka*) occurring in the nearby forest. The pallid rat ("B") I probably would consider a pelage form of group "A" were it not that I find it corresponding very closely to the type of *L. dunni nubalis*, to which it was directly compared. I thus prefer to recognize three forms of the *barbarus* group in this region. That a more conservative person or one with a greater series of specimens than have been available to me might lump all three together as fortuitous variations of a single sub-

¹Scientific results of the Congo Expedition, Mammalogy No. 16.

species, I readily admit, but such a procedure would, I believe, with the present evidence, but mask the simple assortment of characters as they have presented themselves and tend to smother rather than encourage further investigation of the problem of speciation or, it may be ecologic differentiation, in this region.

Specimens of each of these three groups were compared with types and other material in the British Museum. At that time I made the nominal assignments used in this paper, from which arrangement I have not had reason to diverge.

For the commonest form I have adopted *zebra* as the name on the single basis that it corresponds to the majority of specimens from the region so labelled in other museums. Heuglin's original description is inadequate for identification and I do not know of the existence of his type. As stated above the pallid form ("B") is recognized as *Lemniscomys dunni nubalis*. The dwarf form I here describe as a new subspecies.

***Lemniscomys oweni orientalis*, new subspecies**

TYPE.—American Museum of Natural History, No. 49626. Congo Expedition Collection No. 1531. Male adult. Collected at Faradje, Belgian Congo, March 16, 1911, by Herbert Lang. The type is a study skin, accompanied by a skull in good condition. Its molars are much worn.

PARATYPES.—American Museum of Natural History, No. 49611, adult male, topotype, collected February 20, 1911, by Mr. Lang; and American Museum No. 2150, adult male, collected at Tingasi, July 15, 1883, by Emin Pasha.

GENERAL CHARACTER.—A small representative of the *barbarus* group related apparently to the Gambian *L. oweni*, from which it differs in possessing a slightly smaller and narrower skull and darker color. From *L. b. zebra*, which is common at the type locality of this new subspecies, it differs conspicuously only in size. From *L. dunni nubalis*, also represented at the same locality, it is easily distinguished on the basis of its smaller size and darker color.

DESCRIPTION.—The median dorsal stripe is blackish, ticked with buffy. Its course is clearly marked from the middle of the crown to the tail base. In the lumbar region it attains its greatest width (2.8 mm.) although this is little more than its width at any point behind the level of the ears. The six pairs of lateral dark stripes are distinctly split by secondary light stripes. These lighten progressively to the pure white abdomen. Two pairs of light stripes may be distinguished above the eyes, the lower of them joining the buffy eye ring. The ears are well haired and a bright cinnamon in color. Fore and hind feet are cinnamon buff.

MEASUREMENTS.—Collector's measurements, taken in the flesh: total length, 196 mm.; tail length, 114; length of hind foot, with claw, 23; height of ear, 15. Skull measurements: greatest length, 26.7; condylobasal length, 24.1; greatest skull height, 10.3; zygomatic breadth, 12.5; interorbital breadth, 4.3; breadth of brain case, 11.6; palatilar length, 10.8; length palatal foramina, 5.5; width of palate across M¹, 5.7; alveolar length upper tooth row, 4.7; crown length upper tooth row, 4.6; width M¹, 1.6; condylo-incisive length of mandible, 16.5.

PELOMYS

Specimens collected by the Reverend Richard Callewaert at Lulua-bourg, Kasai District, Belgian Congo, are known to have been acquired by the British Museum, the National Museum at Madrid, the Congo Museum, the Natural History Museum at Basel, the Berlin Museum, and The American Museum of Natural History. The first published account of the arvicanthine rats of the genus *Pelomys* contained in the Callewaert collections was that of Cabrera and Ruxton (1926, Ann. and Mag. Nat. Hist., (9), XVII, p. 601) on the London and Madrid series, in which *Pelomys minor* was described as new and the remaining series of seventeen specimens, containing two well-marked species (as I have ascertained by personal examination), assigned to *Pelomys campanae* (Huet). Matschie had in manuscript, at the time of his death, a paper on a part of the Basel series in which he described as new the mice already made known under the name of *Pelomys minor*. Matschie's manuscript was published (1926, Zeitschr. f. Säugetierkunde, Bd. 1, p. 114) but his new name for this species was editorially deleted and "*Komemys minor* Cabr. et Ruxt." substituted. There was published, however, in this same paper, the description of *Pelomys luluae* Matschie. It seemed to me that this was a composite description of the two larger *Pelomys* occurring at Luluabourg and that Matschie also had failed to recognize the presence of two species. Since Matschie named no type in his description, I inquired of Dr. Jean Roux of Basel concerning the specimens on which the description was based. Of the four listed in the description, one, No. 3941 (skull No. 7827), a male, taken June 8, 1923, was returned to Basel, bearing a red tag indicative that it was the type. The three other specimens were retained in the Berlin Museum.

It chanced that though the two species in question have skulls that are strikingly different (but one of the British Museum series had been cleaned) they bear great resemblance externally, except for one feature, the basal color of the belly hairs. In one form the hairs are white to their bases, in the other white at the tip, gray at the base. Before specimens could be correctly named it remained to ascertain the color of the hair in the types of the various nominal species.

Huet, in describing *Mus campanae*, mentioned specimens in the Paris Museum. In 1933 with the kind guidance of Dr. Rode, I found two mounted specimens on exhibition (since removed) each labelled the type of *Mus campanae*. In each of these (Nos. 1112 and 1113) the hairs of the underside were completely white. Skulls could not be found.¹

¹On the base of No. 1113 was the following inscription: "Pere Campana, Landana, ♂. Envoi 9 Nov. 1887 *Mus campanae*. C.g. 1888, No. 1. J. Huet."

The type of *Pelomys luluae* Matschie has the hairs of the under-surface gray at their base, as Dr. Roux has determined for me. This then is not a synonym of *P. campanae* (Huet).

The nomenclature of these "mud rats" of the Kasai as I view them should then be as follows:

1.—*Pelomys campanae* (Huet)

Head and body length about 140 mm. Belly hairs completely white. Dorsal stripe usually faint. Diameter of M^1 about 2.0 mm. Cranially this species resembles *Pelomys fallax* more than do the other two species considered.

2.—*Pelomys luluae* Matschie

Head and body length about 150 mm. Belly hairs white at tips, gray at base. Dorsal stripe absent. Diameter of M^1 about 2.3 mm. In external appearance this form is nearer *P. fallax* than are the other two, but its broad teeth and expanded nasals separate it clearly from that species.

3.—*Pelomys* (*Komomys*) *minor* Cabrera and Ruxton

Head and body length about 125 mm. Belly hairs white, gray at base. Dorsal stripe clearly defined. In the clear definition of the dorsal stripe and the shorter fifth digit of the posterior limb, this species approaches *Komomys* which cannot at best be considered more than a subgenus.

It is interesting to note that Father Callewaert or his native collectors distinguished *Pelomys minor* as distinct, calling it under the name "Ngonga," but did not distinguish by name two species among the remaining *Pelomys*, both being called "Ditapa."

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FOUR HITHERTO UNRECOGNIZED SUBSPECIES OF AFRICAN RODENTS

By ROBERT T. HATT

Herein are named and described three geographical variants of species of *Tatera* which have hitherto received insufficient attention in the areas from which I have selected the types. One of these is from a small series secured by Dr. H. E. Anthony, in the Red Sea Hills, and I am pleased to express my appreciation of his permission to describe the subspecies involved. A fourth subspecies named represents the genus *Mastomys*.

The color terms employed, when those of Ridgeway's Standards, are capitalized.

Tatera robusta taylori, new subspecies

TYPE.—American Museum of Natural History, No. 82300. Taylor Sudan Expedition, No. 3111. Female adult. Collected at Khor Birum, Red Sea Hills, Sudan, April 15, 1927, by H. E. Anthony. The type is a study skin with skull, both in good condition, except that the tips of the nasals are broken. The molars are greatly worn.

PARATYPES.—Three adult female topotypes, skins with skulls, collected the same morning as the type. A. M. N. H. Nos. 82299, 82301, 82302.

GENERAL CHARACTER.—This subspecies is closely similar to *T. robusta robusta*, except for its slightly smaller foot and skull, and for the color of the tail hairs, which in *T. r. robusta* is a deep blackish brown, and in *T. r. taylori* is a light brown, near the color of the back. The hairs of the terminal third of the tail are shorter than those on *T. r. robusta*.

DESCRIPTION. General color above, Ochraceous-Tawny, darker on the rump, paling on the sides. The pure white belly is sharply demarcated from the flanks. Facial markings are fairly prominent; the supraorbital and jugal light areas distinct; the suborbital and nasal bars well marked, almost black. The ears are blackened terminally.

The skull of *T. r. taylori* differs from the skull of *T. r. robusta* only in its smaller size, and the greater prominence of the posterior palatal tubercle.

MEASUREMENTS.—Collector's measurements of the type, followed in parentheses by the maximum and minimum measurements of the three paratypes are: total length, 323 mm. (346–322); tail vertebrae, 180 (190–182); hind foot with claw, 38 (38–38). Cranial measurements of the type, followed in parentheses by those of the paratype No. 82299, are: greatest length, ? (40.8 mm.); condylo-incisive length, 35.1 (35.3); zygomatic breadth, 20.3 (20.0); interorbital breadth, 7.6 (7.0); breadth of brain case, 16.0 (16.1); greatest height of skull, 14.3 (14.7); length of nasals, ? (18.0); width of zygomatic plate, 7.7 (7.9); length of bullae, 11.1 (10.9); palatilar length,

18.2 (18.2); length of anterior palatal foramina, 7.2 (7.8); least width of palate inside of M^1 , 3.7 (3.5); crown length upper tooth row, 5.8 (6.0); width of M^1 , 2.1 (2.1); condylo-incisive length of mandible, 24.3 (23.8).

The race is named for Mr. Irving K. Taylor, sponsor of the expedition which collected these gerbilles, and co-collector with Dr. Anthony, of the larger mammals secured.

***Tatera nigrita beniensis*, new subspecies**

TYPE.—American Museum of Natural History, No. 82659. Ruwenzori-Kivu Expedition, No. 73. Male adult. Collected at the new post of Beni (Bungulu), eastern Belgian Congo (3900 feet altitude) October 26, 1926, by James P. Chapin. The type is a study skin with skull. The skin is in good condition. The skull is perfect except for the nasals and anterior palatal region which were smashed by the trap. The molars are lightly worn.

PARATYPE.—A. M. N. H. No. 82663. A juvenile female collected at the same locality as the type, October 26, 1926, by Doctor Chapin. Skin with skull.

GENERAL CHARACTER.—Similar to *Tatera nigrita* from northwestern Uganda (to the type of which I have compared the type of the subspecies here proposed) but larger, shorter tailed, darker colored. *T. n. beniensis* has shorter posterior palatal foramina, and the outline of M^1 as seen in the ventral view, is more pyramidal than in the earlier named form, but the skulls do not differ greatly in other respects.

DESCRIPTION.—General color above, blackish, suffused with Wood Brown. The flanks are near the latter color. Belly, throat, chin, and the lower cheek hairs, pure white, as are also those of hands and feet. No facial markings. Outer surface of the ear clothed with blackish-brown hair. Hairs of the dorsum of the tail blackish brown, those of the underside, white. There is no sharp line of demarcation between the two. The hair of the middle of the back measures about 16 mm. long. The ears are relatively small.

MEASUREMENTS.—Collector's measurements of the type are: total length, 274 mm.; tail vertebrae, 128; hind foot with claw, 35. Cranial measurements of the type (followed in parentheses by corresponding measurements which I have taken from the type of *T. nigrita*) are: basilar length, circa 31.3 (29.8); condylo-incisive length, circa 35.0 (34.5); zygomatic breadth, 19.8; interorbital breadth, 6.6 (6.4); squamosal breadth of brain case, 16.5 (16.5); height of brain case from basal suture, 12.8 (12.2); height of brain case from bullae, 15.1 (14.9); length of bullae, 10.3 (10.8); width of palate inside the posterior loph of M^1 , 3.2 (3.3); length of posterior palatal foramina, 2.6 (3.4); alveolar length of upper tooth row, 7.2 (7.0); width of M^1 , 2.6; condylo-incisive length of mandible, 24.2.

In the Musée du Congo Belge are two specimens of this race, one collected at Beni by Lt. Bonnevie and one at Boga by M. Collart.

***Tatera nyassae loveridgei*, new subspecies**

TYPE.—American Museum of Natural History, No. 55584. Female adult. Collected at Kilossa, Tanganyika Territory, December 16, 1920, by Arthur Loveridge. The specimen is a skin with skull, both in good condition.

PARATYPE.—A. M. N. H. No. 55499. An adult female, skin with skull, collected at the type locality, January 22, 1921, by Mr. Loveridge.

GENERAL CHARACTER.—A northeastern race of *T. nyassae* with a dark coloration approaching but not equalling in intensity that of a southern race of the same species, *T. nyassae shirensis*. In size it closely parallels the Nyassaland representatives. Cranial characters, if present, cannot at this time, be established.

DESCRIPTION.—General color above near Fuscous, changing on the sides to a bright Cinnamon-Buff. There is an obscure broad area of gray about the eye. The outer surface of the ears is a blackish brown. Belly, throat, chin, hands, and feet are pure white. The moderately well-haired tail is Cinnamon-Buff, sprinkled with black above, white below.

MEASUREMENTS.—Collector's measurements of the type, followed in parentheses by those of the paratype, are: head and body, 145 mm. (150); tail, 150 (153); hind foot, 31 (33); ear, 28 (23). Cranial measurements of these specimens are: greatest length, 39.0 (38.8); condylo-incisive length, 35.1 (34.9); zygomatic breadth, 20.0 (20.4); interorbital breadth, 6.4 (6.0); breadth of brain case, 15.9 (16.7); greatest height of skull, 14.7 (15.4); length of nasals, 14.9 (15.1); width of zygomatic plate, 7.7 (6.7); length of bullae, 10.4 (10.7); palatilar length, 17.7 (17.2); length of anterior palatal foramina, 7.4 (7.9); least width of palate inside M^1 , 3.3 (2.8); crown length of upper molar row, 6.7 (6.5); width of M^1 , 2.6 (2.6); condylo-incisive length of mandible, 24.7 (24.5).

***Mastomys coucha itigiensis*, new subspecies**

TYPE.—American Museum of Natural History, No. 55571. Female adult. Collected at Gwaos, near Itigi, Tanganyika Territory, October 10, 1921, by Arthur Loveridge. The type is a skin with skull. The skull is complete. The molars are moderately worn.

PARATYPES.—There are three paratypes in the American Museum: No. 55668, a young adult male topotype; No. 55526, a young adult male from Jumbo Mbulu's, near Singidda; and No. 55534, a young adult female, also from Mbulu's. Three additional topotypes from the same original collection are in the Museum of Comparative Zoölogy. These are Nos. 22919, 22920, 22921; adult male, adult female and subadult female.

GENERAL CHARACTER.—A pallid race closely related to *victoriae*.

DESCRIPTION.—The description, based on the type, would apply almost equally well to any of the paratypes, except the smallest, which is somewhat paler than the others.

General color above, from crown to tail base, Avellaneous, slightly overwashed with Natal Brown of the hair tips. The flanks are colored as the back, except that they lack the dark overwash. The face and cheeks are of much the same color as the flanks although below the eyes are slightly clearer in tone. The ears are contrastingly dark brown and sparsely covered with hairs, buffy inside the pinna, darker outside. The dorsum of each fore foot is covered with Warm Buffy hair. The hair of the hind feet is clear white. The scales and short hair of the dorsal surface of the tail are near Prout's Brown, those of the underside, white. There is not a sharp line of demarcation between the two. The entire undersurface of the body is covered with hair, the basal part of which is Neutral Gray, the tip White. There are eleven or more pairs of mammae.

MEASUREMENTS.—Collector's measurements of the type and two paratypes, are given in the following table:

NUMBER	SEX	HEAD-BODY	TAIL	FOOT	EAR
Type	♀	95	92	21	16
22920	♂	110	120	22	16
22921	♀	95	101	20	16

Cranial measurements of the type are: greatest length, 26.7 mm.; condylo-incisive length, 24.3; zygomatic breadth, 13.1; breadth of brain case, 11.8; inter-orbital constriction, 4.2; greatest length of nasal, 11.4; length palatal foramina, 6.2; width of palate across M¹, 5.8; greatest length upper tooth row, 4.7; width M¹, 1.6.

It may be here noted that Loveridge (1923, P. Z. S. London, p. 702) has observed of these specimens that: "Specimens from the thorn-bush steppe seem to average smaller and are paler, but can be matched by individuals picked out from the Kilosa District series." With the major part of the series to which Mr. Loveridge referred, here at hand, I have been unable to agree with the conclusion quoted. A few specimens of the other series, referred in the paper quoted to *Mastomys c. microdon* (Peters) but better referred to *M. c. victoriae* (Matschie), are pale, but none of them of quite the same light color shown in this series. One specimen from Isikisia, near Tabora, Tanganyika Territory, should also be referred to the race here described, but in its slightly darker coloration is not quite typical.

The Tanganyika representatives of this genus appear, as far as I have been able to determine, to sort into local types, as though representative of a single species. Specimens from the region of Mbulu (not Mbulu's) are about intermediate between *victoriae* and *panya*, the latter of which is known from localities in Kenya Colony, near the Tanganyika boundary. The greater number of specimens from the central section of the Territory may be referred to *victoriae*, a race differing in little but coloration from *panya*, and averaging much the same in size. *Mastomys c. itigiensis* appears to be confined to the thick thorny scrub which occupies the region of the type locality.

I am indebted to Mr. Loveridge for the loan of the Museum of Comparative Zoology specimens cited.

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SPIDERS FROM THE SOUTHWESTERN UNITED STATES, WITH DESCRIPTIONS OF NEW SPECIES

BY W. J. GERTSCH

The following paper is for the most part a report on a collection of spiders taken in Arizona by a field party from The American Museum of Natural History headed by Dr. F. E. Lutz. Although spiders were to an extent incidental to the purpose of the expedition, namely the collecting of insects, a number of species were taken and are listed below. During the course of the trip the chasm of the Grand Canyon, the highly interesting plateau regions of the north and south rims, and the San Francisco Mountains were investigated. The paper has been considerably expanded by the inclusion of various new species and new records from material collected in Arizona by Dr. Lutz on previous trips, and particularly by descriptions of unusual species taken in southern Texas by Mr. Stanley Mulaik.

Of paramount interest are the records of two families of spiders not heretofore reported from the United States. *Tama mexicana* (Cambridge), a representative of the Hersiliidae, has been found by Mr. Mulaik to be a fairly common spider in southern Texas. From the same region comes *Zorocrates aemulus*, a new species of the family Zoropsidae. A single immature female of a second species of the genus was taken by Dr. Lutz in Arizona, in 1916, and seems to be *Zorocrates mistus* (Cambridge). In addition, a second species of the curious two-eyed spiders of the family Caponiidae and another *Filistata* are recorded from the United States.

The types of the species described as new are in the collection of The American Museum of Natural History.

SUBORDER MYGALOMORPHAE

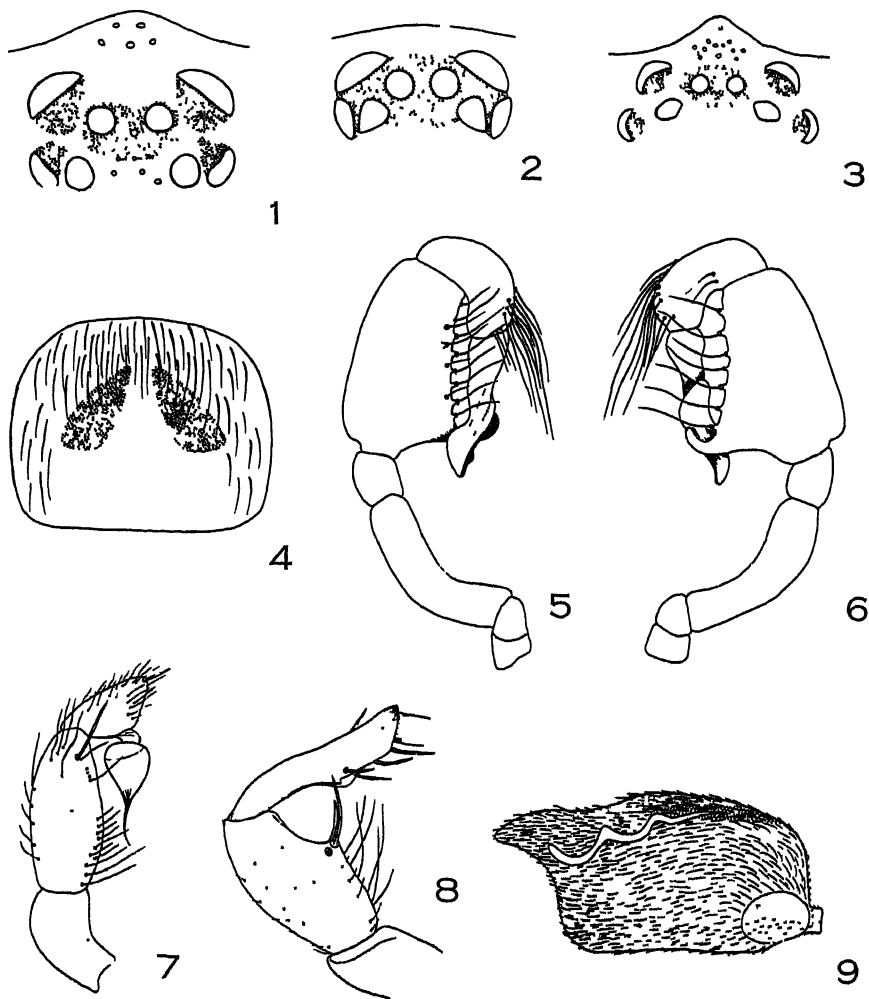
CTENIZIDAE

Hebestatis theveneti (Simon)

Figure 1

Cyclocosmia theveneti SIMON, 1890, Actes Soc. Linn., Bordeaux, XLIV, p. 313.

RECORD.—Bizbee, Arizona, 1907, female (Edmundson).



- Fig. 1. *Hebestatis theveneti* (Simon), eyes of female.
 Fig. 2. *Evagrus comstocki*, new species, eyes of male.
 Fig. 3. *Myrmekeiaphila comstocki* Bishop and Crosby, eyes of female.
 Fig. 4. *Filistata crassipalpus*, new species, epigynum.
 Fig. 5. *Filistata crassipalpus*, new species, palp, retrolateral view.
 Fig. 6. *Filistata crassipalpus*, new species, palp, prolateral view.
 Fig. 7. *Evagrus comstocki*, new species, palp.
 Fig. 8. *Evagrus comstocki*, new species, second leg of male.
 Fig. 9. *Diguetia caudata*, new species, abdomen of female.

Myrmekiaphila fluviatilis (Hentz)

Mygale fluviatilis HENTZ, 1850, Jour. Boston Soc. Nat. Hist., VI, p. 286, Pl. x, fig. 15.

RECORDS.—Kingsville, Texas, female (Clyde T. Reed). Mission, Texas, female. Austin, Texas, July, 1903, female (Det. by A. Petrunkevitch).

Myrmekiaphila comstocki Bishop and Crosby

Figure 3

Myrmekiaphila comstocki BISHOP AND CROSBY, 1926, Jour. Elisha Mitchell Sci. Soc., XLI, p. 168, Figs. 7 and 8.

RECORD.—Edinburg, Texas, two females (S. Mulaik).

DIPLURIDAE**Evagrus comstocki**, new species

Figures 2, 7, and 8

MALE.—Total length, exclusive of chelicerae and spinnerets, 8.00 mm. Carapace, 3.75 mm. long, 2.85 mm. wide.

Carapace and legs dull yellow, the abdomen gray. Eyes enclosing a black field. Carapace oval, weakly truncated in front, flat. Circular thoracic fovea somewhat behind the middle of the carapace, from which radiate four pairs of striae, the first pair limiting the V-shaped, slightly elevated pars cephalica.

Eyes occupying two-fifths of the width of the carapace at that point. Clypeus only two-thirds as high as the diameter of an anterior median eye. First row of eyes procurved, equidistantly spaced, the medians half as large as the laterals. Second row of eyes very slightly recurved, the medians subtriangular in shape, slightly smaller than the oval lateral eyes. Posterior median eyes separated by about twice their diameter, subcontiguous with the laterals. Median ocular quadrangle much broader than long, narrowed in front, the eyes subequal.

Sternum longer than broad (14/9), subquadrangular, weakly rounded behind. Coxae subequal, the posterior pair contiguous. Labium three times as broad as high, one-fifth as high as the divergent endites. Under side armed with a few spines and hairs. Chelicerae strongly convex, lacking rastellum, armed with stiff spines, the outer margin of the furrow with a band of hairs, the inner with ten or twelve unequal teeth.

Legs comparatively short, the first femur and patella about equal in length to the carapace. Palpus as figured. Leg formula, 4132.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	2.25	1.37	1.50	1.55	1.00	7.67 mm.
II	2.12	1.25	1.38	1.50	1.08	7.33 mm.
III	2.12	1.08	1.38	1.95	1.10	7.63 mm.
IV	2.56	1.55	2.00	2.25	1.40	9.76 mm.

First femur with a retrolateral, the second with a prolateral patch of tiny setae. Legs provided with black hairs and some spines. First tibia with six conspicuous

prolateral and twelve ventral spines. Second leg modified, as usual in the genus, as shown in the figure.

Abdomen about two-thirds as broad as long, rather thickly clothed with black hairs and spines. Spinnerets four, the one-jointed median ones small, the outer ones made up of three subequal joints, the whole spinneret nearly as long as the tibia and patella of the fourth leg (8/9).

FEMALE.—Total length, exclusive of chelicerae and spinnerets, 9.00 mm. Carapace, 3.85 mm. long, 2.90 mm. wide. The whole spider lightly infuscated. Structure as in the male. Lateral spinnerets, 3.50 mm. long. Spines beneath first tibia, 2-2, beneath first metatarsus, 1-2-2-1-2.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	2.25	1.50	1.50	1.50	1.00	7.75 mm.
II	2.25	1.40	1.40	1.50	1.00	7.55 mm.
III	2.00	1.25	1.40	2.00	1.12	7.77 mm.
IV	2.75	1.50	2.00	2.56	1.30	10.11 mm.

TYPE LOCALITY.—Male holotype from Edinburg, Texas (S. Mulaik). Female allotype from one-half mile east of Rio Grande City, Texas, Nov. 11, 1934 (S. Mulaik). Female paratype from east of Laredo, Texas, Nov. 11, 1934 (S. Mulaik). Female paratype from Sanderson, Texas, July 4, 1934 (S. Mulaik). Female paratypes from Austin, Texas, Sept., 1909 (A. Petrunkevitch).

This species is closely related to *Evagrus pragmaticus* Chamberlin from Sonora, but the differences in the structure of the second leg of the male and in the eye relations seem to warrant its description as new. The female paratypes from Austin differ considerably in color from the allotype, and it would not be surprising if, upon discovery of a male, the two were found to represent distinct species.

AVICULARIIDAE

Eurypelma marxi Simon

Eurypelma marxi SIMON, 1890, Actes Soc. Linn., Bordeaux, XLIV, p. 324.

RECORDS.—Edinburg, Texas, June, 1934, female (S. Mulaik). Jemez Springs Mountains, New Mexico, male, female. Fruita, Utah, July 14, 1931, male (Gertsch).

Eurypelma californica Ausserer

Eurypelma californica AUSSERER, 1871, Verh. k. k. Zool.-Bot. Gesell., Wien, XXI, p. 214.

RECORD.—Tucson, Arizona, July and Aug., 1934, many females, four males (P. Steckler).

Eurypelma steindachneri Ausserer

Eurypelma steindachneri AUSSERER, 1875, Verh. k. k. Zool.-Bot. Gesell., Wien, XXV, p. 199, Pl. VII, figs. 43-44.

RECORD.—Phantom Ranch, Grand Canyon, Arizona, July 26, 1934, male (F. E. Lutz).

SUBORDER DIPNEUMONOMORPHAE

FILISTATIDAE**Filistata crassipalpus**, new species

Figures 4, 5, and 6

MALE.—Total length, 1.50 mm. Carapace, 0.69 mm. long, 0.62 mm. wide. Abdomen, 1.00 mm. long, 0.50 mm. wide.

Cephalothorax mainly dark brown, the margins and eye region black, clothed with a few inconspicuous scales. Carapace about as broad as long, almost round, the sides slightly flattened, the clypeal portion a rounded projection. Carapace weakly convex, the longitudinal median furrow well indicated, the lateral margins turned up to form a submarginal trough or furrow. Eye group elevated on a tubercle. Eyes occupying half the width of the carapace at that point, the rows equally wide. First row of eyes procurved, the medians separated by half their radius, about as far from the much larger lateral eyes (13/9). Second eye row straight, the medians separated by a diameter, subcontiguous with the slightly larger laterals (12/11). Median ocular quadrangle three-fourths as long as broad, the anterior eyes slightly smaller. Sternum longer than broad (7/6), well rounded on the sides, bluntly pointed behind where the fourth coxae are separated by one-third their width. Labium five-sixths as broad as long, three-fifths as long as the convergent endites. Abdomen dark brown, longer than broad, clothed with a few gray scales.

Leg formula, 1423. All femora with a dorsal spine at the base; the first and second tibiae with a single median ventral spine. Legs yellow, the femora with a basal, median and distal and the tibiae and metatarsi with basal and distal black annulae. Palpus chelate, as figured.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	0.85	0.29	0.85	0.77	0.44	3.20 mm.
II	0.73	0.24	0.67	0.69	0.31	2.64 mm.
III	0.61	0.24	0.62	0.69	0.31	2.47 mm.
IV	0.85	0.29	0.85	0.85	0.33	3.17 mm.

FEMALE.—Total length, 1.77 mm. Carapace, 0.61 mm. long, 0.61 mm. wide. Abdomen, 1.10 mm. long, 0.85 mm. wide.

Coloration and structure essentially as in the male. Carapace as broad as long, dark brown in color, somewhat streaked, clothed with long, gray scales. Sternum as broad as long. Abdomen much broader than in the male, rather thickly clothed with long, scalelike, gray spines. Legs slightly more robust than in the male, proportionately shorter, the first tibia equal in length to the carapace. Legs lacking the spines that are present in the male. Epigynum as figured.

TYPE LOCALITY.—Male holotype, female allotype and paratype from thirty-two miles east of Laredo, Texas, Nov. 11, 1934, collected by Mr. Stanley Mulaik.

This tiny species seems to differ in no important structural characteristic from the much larger species of *Filistata* found in the United States. The male palpus, though apparently radically different from the palpi of the other species, is essentially identical in details with other members of the genus.

***Filistata hibernalis* (Hentz), variety**

Filistata hibernalis HENTZ, 1842, Jour. Boston Soc. Nat. Hist., IV, p. 227, Pl. VIII, fig. 6.

RECORDS.—Grand Canyon, Arizona, South Rim, July 31, 1934, female (Lutz). Kaibab Plateau, North Rim Grand Canyon, Arizona, July 10, 1931, female (Gertsch). Scottsdale, Arizona, male, females (Britcher). Tucson, Arizona, July and Aug., 1934, females (P. Steckler).

SICARIIDAE

***Plectreurys tristis* Simon**

Plectreurys tristis SIMON, 1893, Ann. Soc. Entom. France, LXII, p. 300.

RECORD.—Fredonia, Arizona, July 9, 1931, two females (Gertsch).

***Diguetia canities* (McCook)**

Segestria canities McCook, 1889, 'American Spiders,' II, p. 136, Figs. 165, 166.

RECORDS.—Edinburg, Texas, male, females (S. Mulaik). Scottsdale, Arizona, Jan. 28, 1903, female (Britcher). St. George, Utah, female (L. A. Woodbury). Chuckawalla Mountains, California, Dec. 20, 1927, female (E. C. Jaeger). Indian Gardens, Grand Canyon, Arizona, July 24, 1934, female (F. E. Lutz). Between Cameron and Lee's Ferry, July 17, 1934, female (F. E. Lutz).

***Diguetia caudata*, new species**

Figure 9

FEMALE.—Holotype: total length, 5.75 mm.; carapace, 2.10 mm. long, 1.25 mm. wide. Paratype: total length, 5.20 mm.

Integument of the carapace light brown, thickly covered on the sides with white scales, the clypeus and the pars cephalica margined with rows of white scales. Carapace much longer than broad, rounded in front and at the caudal end, relatively low and flat, the sutures delimiting the cephalic portion well defined. Triangular pars cephalica two-thirds as long as the total length of the carapace. Eye group five-sevenths as broad as the carapace at that point. Clypeus convex, twice as high as the diameter of a central eye. Lateral eyes subcontiguous, equal in size, placed on slightly elevated, black tubercles, smaller than the subcontiguous median eyes. Line of the

medians and the anterior laterals straight, the medians a diameter from the laterals. Sternum, labium and endites rather thickly clothed with white scales. Sternum scarcely three-fourths as broad as long, bluntly pointed behind where the coxae are but slightly separated, rounded on the sides, squared off in front at the intimate juncture with the labium, at which point the first coxae are separated by the length of the second coxa. Labium broader than long, eight-thirteenths as long as the convergent endites.

Legs yellow, provided with numerous black hairs and very weak spines, annulate as in *Diguetia canities* (McCook) but the rings virtually obsolete, most distinct on the last leg where distal femoral, patellar, and distal tibial annulae are present.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	3.00	0.70	2 37	2.15	0.95	9.17 mm.
II	2 55	0.60	2.00	1.87	0.80	7.82 mm.
III	1.95	0.50	1.20	1.50	0.57	5.72 mm.
IV	2 75	0 60	2.00	2.15	0.70	8 20 mm.

Abdomen nearly twice as long as broad, thickly clothed above and on the sides with yellowish scales, with an indistinct basal dark marking and with two sinuous stripes of white scales above. Venter dark brown. Abdomen with a well-defined caudal appendage as shown in the figure. Spiracle half as far from the spinnerets as the genital furrow.

TYPE LOCALITY.—Female holotype and paratype from Sabino Basin, Santa Catalina Mountains, Arizona, July 8–12, 1916 (F. E. Lutz).

This species closely parallels *Diguetia canities* (McCook) in structure and color pattern and may, upon discovery of the male, prove to be only a variety of that species. However, the possibility is quite as good that it represents a distinct species, for the females of the few known forms are very closely allied. The pronounced caudal appendage distinguishes it from other known species.

Scytodes perfecta Banks

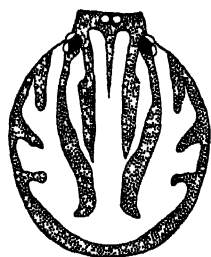
Figures 12 and 17

Scytodes perfecta BANKS, 1898, Proc. California Acad. Sci., (3) I, p. 210, Pl. XIII, fig. 2.

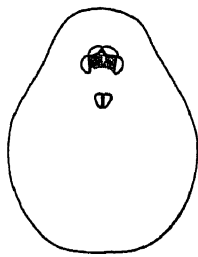
FEMALE.—Total length, 7.00 mm. Carapace, 3.50 mm. long, 3.25 mm. wide. Abdomen, 3.50 mm. long, 3.25 mm. wide.

Integument of the carapace yellow, the dorsum clothed with erect, black hairs, the sides lacking them. Color pattern restricted mainly to the sides as shown in the figure. Carapace about as broad as long, suboval, the front truncate. Carapace strongly convex, highest behind, half as high as the greatest length, the posterior declivity abrupt, the curvature more gradual in front to the clypeus. Sternum armed with a few black hairs, suboval, truncate behind where the fourth coxae are separated by little more than their width, the sides gently rounded.

Eyes on separate black patches. Eyes subequal, the medians contiguous, a little more than their radius from the clypeal margin, the lateral pairs subequal, contiguous. Curvature of the six eyes considerable, a line across the front edge of the



10



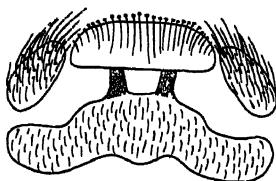
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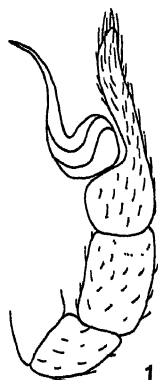
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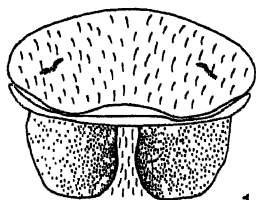
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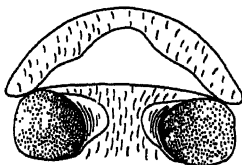
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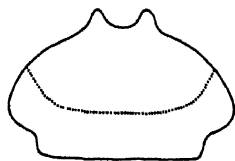
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18

- Fig. 10. *Scytodes dorothea*, new species, carapace of female.
 Fig. 11. *Leptoneta californica* Banks, carapace of female.
 Fig. 12. *Scytodes perfecta* Banks, carapace of female.
 Fig. 13. *Scytodes dorothea*, new species, palpus.
 Fig. 14. *Psilochorus pullulus* (Hentz), epigynum.
 Fig. 15. *Scytodes intricata* Banks, palpus.
 Fig. 16. *Scytodes intricata* Banks, epigynum.
 Fig. 17. *Scytodes perfecta* Banks, epigynum.
 Fig. 18. *Psilochorus rockefelleri*, new species, epigynal ridges.

anterior laterals, when all eyes are viewed on the same plane, is over a diameter from the median eyes. Width of the lateral pairs of eyes equal to the carapace at that point.

Legs long, yellow, clothed with rows of black hairs, the patellae with an incomplete black ring. Second legs missing.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	4.00	0.80	4.25	5.50	0.75	15.30 mm.
III	2.62	0.80	2.60	3.12	0.62	9.76 mm.
IV	3.62	0.80	3.82	4.00	0.75	12.99 mm.

Abdomen clothed with black hairs, gray in color, with four rows of black spots in the caudal half. Epigynum as figured.

RECORDS.—Tucson, Arizona, July and Aug., 1934, female (Peter Steckler). Edinburg, Texas, March and April, 1934, two immature females (S. Mulaik).

***Scytodes intricata* Banks**

Figures 15 and 16

Scytodes intricata BANKS, 1909, Proc. Acad. Nat. Sci. Philadelphia, VI, p. 196, Pl. VI, fig. 24.

This is the species that Comstock recorded from Texas as *Scytodes longipes* Lucas in 'The Spider Book.' *Scytodes intricata* differs from that species in the details of the epigynum and palpus, which are figured, and in the much shorter legs. I have seen two females of the true *longipes* from Key West, Florida, collected July 14, 1934. Seven species of the genus *Scytodes* are now known from the United States, all but *Scytodes thoracica* confined to the extreme southern states. *Scytodes fusca* Walckenaer, *S. championi* Cambridge, *S. intricata* Banks, *S. perfecta* Banks, and *S. dorothea*, a new species described below, are known from southern Texas, all these notable records due to the indefatigable collecting of Mr. and Mrs. Stanley Mulaik of Edinburg, Texas.

***Scytodes dorothea*, new species**

Figures 10 and 13

MALE.—Total length, 3.10 mm. Carapace, 1.60 mm. long, 1.38 mm. wide.

Integument of the carapace dull yellow, sparsely set with erect black spines. Carapace longer than broad, suboval, the pars cephalica abruptly delimited from the thoracic curvature, the front truncate. Carapace strongly convex, a little higher at the caudal end, abruptly dropping behind to the margin, more gradually inclined in front to the clypeus. Dorsum with two broken, purplish-black stripes above, with a dark marginal band. Sternum oval, yellow, armed with black hairs. Coxae subequal.

Eyes enclosed in the black dorsal bands. Eyes subequal, the medians contiguous, a little more than their radius from the clypeal margin, the lateral pairs equal in size, contiguous. Curvature of the six eyes moderate, a line across the front edge of the anterior laterals, when all eyes are viewed on the same plane, is only a radius

from the edge of the medians. Width of the lateral pairs of eyes two-thirds the width of the carapace at that point.

Palpus as figured. Legs moderately long, the first tibia being as long, the femur as wide as the carapace. Legs yellow, unmarked, armed with rows of black hairs.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	1.38	0.37	1.65	1.82	0.40	5.62 mm.
II	1.20	0.37	1.20	0.09	0.30	3.97 mm.
III	1.00	0.35	0.85	1.30	0.40	3.90 mm.
IV	1.30	0.37	1.37	1.30	0.40	4.74 mm.

Abdomen armed with black spines, black in color, with a longitudinal dorsal and two transverse light stripes.

FEMALE.—Total length, 4.00 mm. Carapace, 1.50 mm. long, 1.30 mm. wide. Abdomen, 2.50 mm. long, 1.70 mm. wide.

Color pattern agreeing well with the male, but the dorsal bands wider. Carapace proportionately higher than in the male, much more convex, the caudal declivity and sides dropping more abruptly. Abdomen longer than broad, oval, cylindrical, with a median pale stripe and three oblique side stripes. Eyes as in the male. Legs shorter and weaker than in the male, yellow, the tibiae with basal and distal dark bands.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	1.00	0.30	1.00	1.07	0.37	3.74 mm.
II	0.75	0.30	0.80	0.80	0.32	2.97 mm.
III	0.70	0.30	0.57	0.60	0.30	2.47 mm.
IV	1.00	0.35	1.00	0.87	0.37	3.59 mm.

TYPE LOCALITY.—Male holotype from Edinburg, Texas, Oct. 22–25, 1934. Female allotype and paratype from Edinburg, Texas, March and April, 1934. Female paratype from Arroyo Colorado, Cameron County, Texas, Sept., 1934. All the material was collected by Mr. Stanley Mulaik.

This fine species is named for Mrs. Stanley Mulaik.

PHOLCIDAE

Artema atlanta Walckenaer

Artema atlanta WALCKENAER, 1837, 'Insectes Aptères,' I, p. 656.

RECORD.—Ruins near Tucson, Arizona, July and Aug., 1394, many males and females (P. Steckler).

This large, well-known species is common throughout tropical America but apparently has not heretofore been recorded from within the limits of the United States.

Physocyclus tanneri Chamberlin

Physocyclus tanneri CHAMBERLIN, 1921, Canadian Entomologist, LIII, p. 245, Figs. 1–3.

RECORD.—Supai, Havasu Canyon, Arizona, Aug. 2, 1934, immature female (F. E. Lutz).

A single immature specimen in the collection probably belongs to this species which is common in the region around St. George, Utah. *Physocyclus enaulus* Crosby, a closely allied species, is found in New Mexico and Texas and is no doubt the species usually reported as *P. globosus* from the southwestern States. *Physocyclus neomexicanus* Chamberlin and Gertsch is a synonym of *enaulus*. The only specimen of the true *globosus* that I have seen from the United States comes from Florida.

***Pholcophora texana*, new species**

Figures 22, 23, and 24

MALE.—Total length, 1.28 mm. Carapace, 0.64 mm. long, 0.53 mm. wide.

Carapace and appendages yellow, the abdomen gray. Eyes on a black field. Carapace subtriangular, convex, longer than broad, broadest at the third coxae, truncated behind, considerably narrowed in front, highest just behind the ocular area. Median and cephalic sutures poorly indicated.

Anterior row of eyes procurved (slightly recurved in dorsal aspect), the eyes subcontiguous, the medians very small, the laterals larger than the posterior eyes. Posterior eye row slightly recurved, the eyes subequal in size, the medians separated by one diameter, subcontiguous with the laterals. Median ocular quadrangle broader than long (10/7), a little more than half as wide in front, the anterior median eyes much smaller. Clypeus sloping, three times as high as the diameter of an anterior median eye.

Sternum broader than long (27/22), truncated in front and provided with a blunt apophysis on each side. Labium subtriangular, broader than long. Endites strongly convergent, contiguous at the distal ends. Chelicera armed at the base on the outer side with a long, straight spine, twice as long as in *Pholcophora americana* Banks. Legs provided with rows of black hairs. Abdomen thickly set with strong, black bristles. Palpus as figured.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	0.93	0.21	0.93	0.98	0.36	3.41 mm.
II	0.74	0.20	0.64	0.78	0.32	2.68 mm.
III	0.63	0.15	0.54	0.78	0.31	2.41 mm.
IV	1.00	0.21	0.94	1.04	....	.....

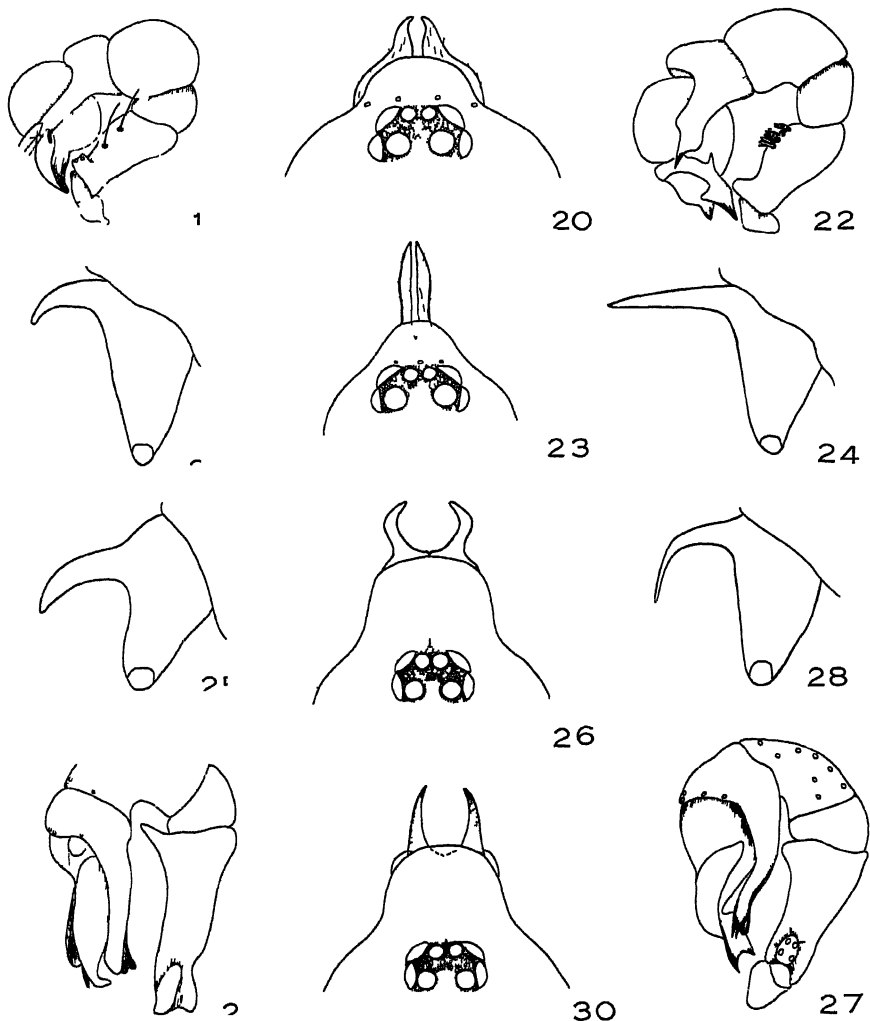
TYPE LOCALITY.—Male holotype and immature female allotype from a Brick Yard, one-half mile east of Rio Grande City, Texas, Nov. 11, 1934 (S. Mulaik).

***Pholcophora americana* Banks**

Figures 19, 20, and 21

Pholcophora americana BANKS, 1893, TRANS. AMERICAN ENT. SOC., XXIII, p. 57.

RECORDS.—Lehi, Utah, August, 1930, male, female (Gertsch). Yellowstone National Park, Wyoming, Aug. 10, 1931, two males (W. E.



- Fig. 19. *Pholcophora americana* Banks, palpus.
 Fig. 20. *Pholcophora americana* Banks, eyes and cheliceral spines.
 Fig. 21. *Pholcophora americana* Banks, chelicera, lateral view.
 Fig. 22. *Pholcophora texana*, new species, palpus.
 Fig. 23. *Pholcophora texana*, new species, eyes and cheliceral spines.
 Fig. 24. *Pholcophora texana*, new species, chelicera, lateral view.
 Fig. 25. *Psilochorus pullulus* (Hentz), chelicera, lateral view.
 Fig. 26. *Psilochorus pullulus* (Hentz), eyes and cheliceral spines.
 Fig. 27. *Psilochorus pullulus* (Hentz), palpus.
 Fig. 28. *Psilochorus pallidulus*, new species, chelicera, lateral view.
 Fig. 29. *Psilochorus pallidulus*, new species, palpus.
 Fig. 30. *Psilochorus pallidulus*, new species, eyes and cheliceral spines.

Gertsch). Boise River, above Arrowrock Dam, Idaho, June 11, 1931, male, females (W. Ivie). LaSalle, Flathead Co., Montana, males, females (C. Jellison, Jr.). Near Medford, Oregon, females (Fender).

This interesting little species, originally described from Colorado, is fairly common throughout the western part of the United States. As it has never been illustrated, figures are given for comparison with *Pholcophora texana*, new species. The important differences in the structure of the cheliceral spines, the much larger size, and the details of the palpus readily separate *americana* from the second known species in the genus.

***Psilochorus rockefelleri*, new species**

Figure 18

FEMALE.—Total length, 2.25 mm. Carapace, 0.88 mm. long, 0.87 mm. wide.

Integument of the carapace pale yellow, the head portion and clypeus infuscated, the eyes ringed in black, the cephalic sutures blackened. Carapace as broad as long, the pars thoracica convex, the pars cephalica strongly elevated. Sutures deep, the median one going back nearly to the truncate caudal margin. Eyes of the first row procurved, subcontiguous, the medians half as large as the laterals. Eyes of the second row very slightly recurved, equal in size and equal to the anterior laterals, the medians subcontiguous with the laterals, separated from each other by one diameter. Median ocular quadrangle much broader than long, considerably narrowed in front, the anterior medians half as large as the posterior eyes. Head portion and clypeus armed with a few erect, weak spines. Clypeus sloping, concave, about twice as high as the length of the ocular area. Sternum broader than long (10/8.5), weakly rounded behind where the posterior coxae are separated by their length, truncate in front. Labium broader than long (3/1), one-third as high as the strongly convergent endites. First and fourth coxae subequal, a little longer than the equal second and third coxae. Under parts armed with a very few erect hairs. Femur of the first leg about three and one-half times as long as the carapace.

Abdomen subglobose, mainly blue in color, with white and black spots showing through the integument. Epigynal ridges very much as in the other species but armed with two well-defined tubercles as shown in the figure.

TYPE LOCALITY.—Female holotype from south of Flagstaff, Arizona, near James Crossing of Clear Creek, July 22, 1934 (F. E. Lutz).

The presence of distinct tubercular eminences on the epigynal ridges will differentiate this species from any heretofore described from the United States.

***Psilochorus pallidulus*, new species**

Figures 28, 29, and 30

MALE.—Total length, 1.75 mm. Carapace, 0.85 mm. long, 0.80 mm. wide.

Integument of the carapace dull yellow, the eyes in a black field, the median suture blackened. Carapace about as broad as long, the pars cephalica elevated above the convex cephalic portion, delimited by deep sutures. Eyes of the first row

procurved, subcontiguous, the medians half as large as the laterals. Eyes of the posterior row straight, the medians separated by a diameter, subcontiguous with the equal laterals. Posterior eyes equal to the anterior laterals. Median ocular quadrangle about two-thirds as long as broad, half as broad in front, the anterior medians half as large as the posterior eyes. Clypeus twice as high as the length of the ocular area. Chelicerae armed with curved basal spines as illustrated in the figures. Sternum and labium as in *P. rockefelleri*, the endites armed near the base with a rounded tubercle. Femur of the first leg three and a half times as long as the carapace. Palpus as figured.

Abdomen subglobose, dull yellow in color, the dorsum with a few small black spots at the caudal end.

TYPE LOCALITY.—Male holotype from Edinburg, Texas, Sept. to Dec., 1933 (S. Mulaik).

The single male is not in a good state of preservation, but the differences in the structure of the mandibular spines make the identification of this species easy. The palpus differs little from the other members of the genus.

***Psilochorus pullulus* (Hentz)**

Figures 14, 25, 26, and 27

Theridion pullulum HENTZ, 1850, Jour. Boston Soc. Nat. Hist., VI, p. 282, Pl. x, fig. 5.

This seems to be the common species of the genus in southern Texas and is also widely distributed in the southeastern States. *Psilochorus utahensis* Chamberlin is closely allied but is a larger spider and has the palpus more elongate. The cheliceral spines are very similar in the two species. Figures of *pullulus* are given for comparison with *Psilochorus pallidulus*, new species.

DICTYNIDAE

***Dictynina eutypa* (Chamberlin and Gertsch)**

Dictyna eutypa CHAMBERLIN AND GERTSCH, 1929, Pomona College Jour. Ent. and Zool., XXI, p. 101, Pl. I, fig. 2.

RECORDS.—Phantom Ranch, Grand Canyon, Arizona, July 26, 1934, two females (F. E. Lutz); one female (D. Rockefeller). Scottsdale, Arizona, Jan. 16, 1903, male, females (Britcher).

***Dictyna uintana* Chamberlin**

Dictyna uintana CHAMBERLIN, 1919, Ann. Ent. Soc. America, XII, p. 240, Pl. XIV, figs. 3–5.

RECORDS.—Aspen Spring, San Francisco Mountains, Arizona, Aug. 11, 1934, female (D. Rockefeller). San Francisco Mountains, Arizona, 8000 feet, Aug. 13, 1934, female (D. Rockefeller); 12,600 feet, Aug. 12, 1934, female (D. Rockefeller).

Dictyna completa Chamberlin and Gertsch

Dictyna completa CHAMBERLIN AND GERTSCH, 1929, Pomona College Jour. Ent. and Zool., p. 101, Pl. I, fig. 1.

RECORDS.—North Rim of Grand Canyon, Arizona, 9000 feet, July 19, 1934, female (P. E. Geier). Kaibab Plateau, North Rim of Grand Canyon, Arizona, July 11, 1931, male, females (Gertsch).

Dictyna trivittata (Banks)

Lethia trivittata BANKS, 1901, Proc. Acad. Nat. Sci. Philadelphia, p. 577, Pl. XXXII, figs. 9, 10.

RECORD.—Aspen Spring, San Francisco Mountains, Arizona, Aug. 10, 1934, female (E. L. Bell).

The generic position of this species is uncertain. It is certainly not a *Lathys* and likewise does not belong in *Dictynoides*, which genus seems to be synonymous with *Dictynina*.

MICRYPHANTIDAE**Eperigone taibo** Chamberlin and Ivie

Eperigone taibo CHAMBERLIN AND IVIE, 1933, Bull. Univ. of Utah, XXIII, pp. 12-13, Pl. III, figs. 26, 27, Pl. IV, figs. 28-31.

RECORD.—Near Aspen Spring, San Francisco Mountains, Arizona, Aug. 10, 1934, male (F. E. Lutz).

Horcotes quadricristatus Emerton

Lophocarenum quadricristatum EMERTON, 1882, Conn. Acad. Arts and Sci., V, p. 48, Pl. XIII, fig. 3.

Horcotes quadricristatus CROSBY AND BISHOP, 1933, Annals Ent. Soc. America, XXVI, pp. 151-152, Pl. VII, figs. 170-176.

RECORDS.—Near Aspen Spring, San Francisco Mountains, Aug. 13, 1934, two males (D. Rockefeller).

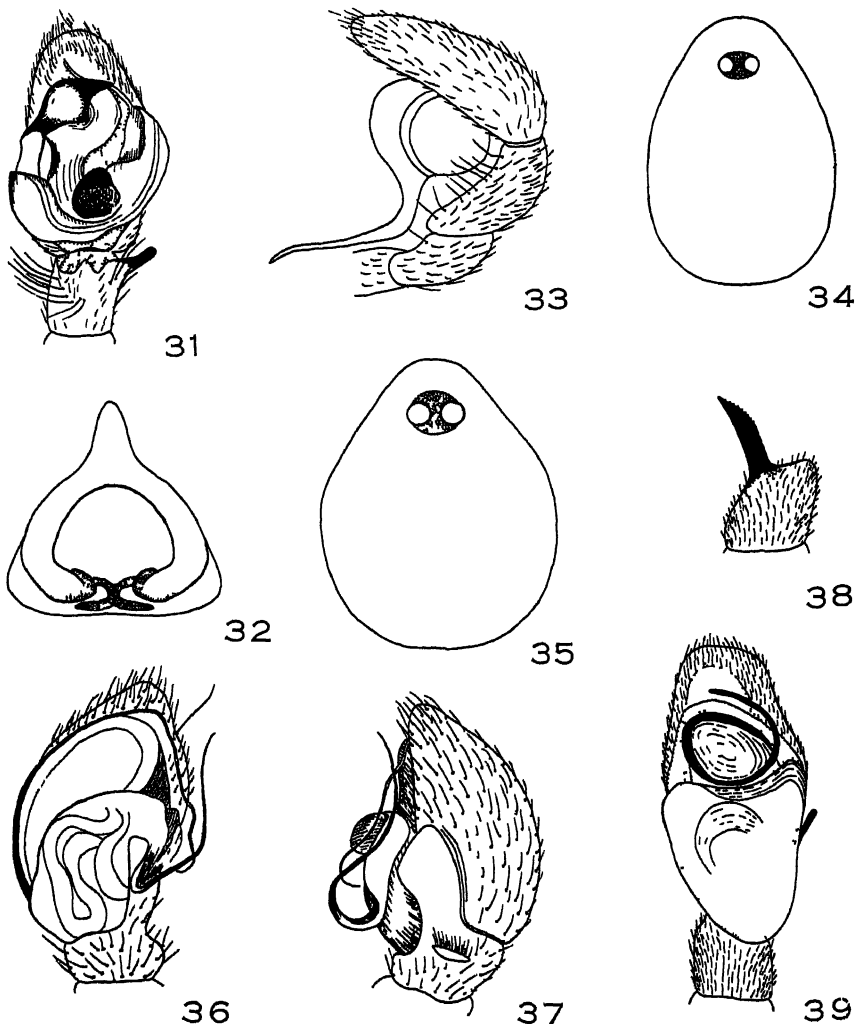
This distinctive species has heretofore been recorded only from Mt. Washington, New Hampshire.

AGELENIDAE**Chorizomma texana**, new species

Figures 36 and 37

MALE.—Total length, 2.20 mm. Carapace, 1.00 mm. long, 0.75 mm. wide. Abdomen, 1.15 mm. long, 0.75 mm. wide.

Whole spider white to pale yellow, the legs and palpi distally light brown. Carapace convex, the sutures obsolete, suboval in outline, clothed with a sparse covering of fine black hairs. Eyes six, in a closely set group close to the clypeal margin, the group about half as wide as the carapace at that point. Clypeus half as high as the



- Fig. 31. *Zorocrates aemulus*, new species, palpus.
 Fig. 32. *Zorocrates aemulus*, epigynum.
 Fig. 33. *Orthonops gertschi* Chamberlin, palpus.
 Fig. 34. *Orthonops gertschi* Chamberlin, carapace of male.
 Fig. 35. *Tarsonops systematicus* Chamberlin, carapace of female.
 Fig. 36. *Chorizomma texana*, new species, palpus, ventral view.
 Fig. 37. *Chorizomma texana*, new species, palpus, lateral view.
 Fig. 38. *Habrocestum belli*, new species, tibia of male palpus.
 Fig. 39. *Habrocestum belli*, new species, palpus, ventral view.

diameter of an anterior lateral eye. Anterior lateral eyes separated by a diameter, the medians missing. Posterior eye row straight or very weakly procurved, as viewed from above, the slightly smaller medians separated by over their diameter, half as far from the laterals, which are about equal to the anterior lateral eyes in size. Sternum longer than broad (8/7), truncate behind where the last coxae are separated by their width. Labium broader than long (9/6), three-fifths as high as the endites. Under side armed with fine black hairs. Chelicerae armed on the lower margin with four small teeth.

Legs strongly spinose, the tibiae and metatarsi armed below with three pairs of long spines. All tibiae with two prolateral spines, the first with a median dorsal that is nearly lateral in position. Tibia and patella of the fourth pair of legs about equal to those joints of the first leg, scarcely as long as the width of the carapace. Palpus as figured, the conductor much longer than in *C. californica*.

TYPE LOCALITY.—Male holotype from Llano, Llano Co., Texas Dec., 1934, collected by Mr. L. Irby Davis.

***Cicurina intermedia* Chamberlin and Ivie**

Cicurina intermedia CHAMBERLIN AND IVIE, 1933, Bull. Univ. of Utah, XXIII, pp. 46-48, Pl. XI, figs. 116-118.

RECORD.—Aspen Spring, San Francisco Mountains, Aug. 10, 1934, female (E. L. Bell).

***Agelena californica* Banks**

Agelena californica BANKS, 1896, Jour. New York Ent. Soc., IV, p. 89.

RECORD.—North Rim of Grand Canyon, Arizona, July 19, 1934, male, female (E. L. Bell). Aspen Spring, San Francisco Mountains, Arizona, Aug. 10, 1934, female (E. L. Bell); female (F. E. Lutz).

OXYOPIDAE

***Peucezia viridans* (Hentz)**

Oxyopes viridans HENTZ, 1845, Jour. Boston Soc. Nat. Hist., V, p. 195, Pl. XVII, fig. 2.

RECORD.—Phantom Ranch, Grand Canyon, Arizona, July 24, 1934, immatures (P. E. Geier).

LYCOSIDAE

***Pardosa sabulosa* Banks**

Pardosa sabulosa BANKS, 1898, Proc. California Acad. Sci., (1) I, p. 273, Pl. XVI, fig. 28.

RECORD.—Walnut Canyon, Flagstaff, Arizona, Aug. 18, 1934, female (F. E. Lutz).

***Pardosa mercurialis* Montgomery**

Pardosa mercurialis MONTGOMERY, 1904, Proc. Acad. Nat. Sci. Philadelphia, p. 270, Pl. XIX, figs. 20, 21.

RECORDS.—Indian Gardens, Grand Canyon, Arizona, July 24, 1934, female (F. E. Lutz); three females (E. L. Bell). Phantom Ranch, Grand Canyon, Arizona, July 27, 1934, two females (P. E. Geier); male, female (E. L. Bell). Walnut Canyon, Flagstaff, Arizona, Aug. 18, 1934, female and immatures (F. E. Lutz).

***Pardosa falcifera* F. Cambridge**

Pardosa falcifera F. CAMBRIDGE, 1902, 'Biologia Centrali-Americana,' Araneidea. II, p. 318, Pl. xxx, figs. 23, 24.

RECORD.—Supai, Havasu Canyon, Arizona, Aug. 5, 1934, male, female (E. L. Bell).

***Pardosa yavapa* Chamberlin**

Pardosa yavapa CHAMBERLIN, 1925, Bull. Mus. Comp. Zool., LXVIII, pp. 231, 232.

Pardosa orophila GERTSCH, 1933, American Museum Novitates, No. 636, p. 28, fig. 45.

RECORDS.—North Rim of Grand Canyon, Arizona, July 19, 1934, four females (P. E. Geier); female (E. L. Bell). Near Aspen Spring, San Francisco Mountains, Aug. 10, 1934, male, four females (F. E. Lutz). Fremont Saddle, next to Lowell Peak, San Francisco Mountains, Arizona, 11,000 feet, Aug. 12, 1934, male, female (F. E. Lutz). Near base of Sunset Peak, San Francisco Mountains, Arizona, Aug. 17, 1934, female (F. E. Lutz).

The last-mentioned female has the peculiar epigynum of the type of *Pardosa orophila* Gertsch.

***Pardosa wyuta* Gertsch**

Pardosa atra BANKS, 1894, Jour. New York Ent. Soc., II, p. 52. (Not *atra* Giebel, 1869.)

Pardosa wyuta GERTSCH, 1934, American Museum Novitates, No. 693, p. 17. (New name for *atra* Banks, 1894.)

RECORD.—North Rim Grand Canyon, Arizona, July 19, 1934, two females (P. E. Geier), 9000 feet.

***Pardosa distincta* Blackwall**

Lycosa distincta BLACKWALL, 1846, Annals and Mag. Nat. Hist., London, XVII, p. 32.

RECORD.—North Rim Grand Canyon, Arizona, July 19, 1934, female (P. E. Geier), 9000 feet.

***Pardosa mackenziana* Keyserling**

Lycosa mackenziana KEYSERLING, 1876, Verh. k. k. Zool.-Bot. Gesell., Wien, XXVI, p. 621, Pl. I, fig. 7.

RECORDS.—North Rim of Grand Canyon, Arizona, 9000 feet, July 19, 1934, two females, several immatures (P. E. Geier); female (E. L. Bell). Near Aspen Spring, San Francisco Mountains, Arizona, Aug. 10, 1934, female (F. E. Lutz); two females (E. L. Bell).

***Pardosa groenlandica* (Thorell)**

Lycosa groenlandica THORELL, 1872, Ofvers. K. Vet. Akad. Förh., XXIX, p. 157.

RECORDS.—Timberline to top of Peak, 12,600 feet, San Francisco Mountains, Arizona, Aug. 12, 1934, female (D. Rockefeller). Along fire road from San Francisco Peak to Freidlein Prairie, Aug. 13, 1934, female (P. E. Geier). Aspen Spring, San Francisco Mountains, Arizona, Aug. 14, 1934, female (E. L. Bell).

***Arctosa alpigena* (Doleschal)**

Lycosa albohastata EMERTON, 1894, Trans. Connecticut Acad. Arts and Sci., IX, p. 423, Pl. III, fig. 3.

RECORD.—Doyle Saddle, between Fremont and Agassiz Peaks, San Francisco Mountains, Arizona, 11,500 feet, Aug. 14, 1934, female (P. E. Geier).

***Arctosa chamberlini* Gertsch**

Arctosa chamberlini GERTSCH, 1934, American Museum Novitates, No. 693, pp. 10-11.

RECORD.—Indian Gardens, Grand Canyon, Arizona, July 24, 1934, female (E. L. Bell).

***Arctosa littoralis* (Hentz)**

Lycosa littoralis HENTZ, 1844, Jour. Boston Soc. Nat. Hist., IV, p. 388, Pl. XVII, fig. 9.

RECORDS.—Below Phantom Ranch, Grand Canyon, Arizona, July 28, 1934, male, immatures (E. L. Bell). Supai, Coconino Co., Arizona, Aug. 3, 1934, male (P. E. Geier).

***Tarentula kochi* Keyserling**

Tarentula kochi KEYSERLING, 1876, Verh. k. k. Zool.-Bot. Gesell., Wien, XXVI, p. 636, Pl. I, fig. 18.

RECORDS.—Near Bright Angel Spring, North Rim Grand Canyon, Arizona, July 18, 1934, female (F. E. Lutz). North Rim Grand Canyon, Arizona, July 19, 1934, immature females (E. L. Bell). Near Neal

Spring, North Rim Grand Canyon, Arizona, July 18, 1934, female (F. E. Lutz). Near Aspen Spring, San Francisco Mountains, Arizona, Aug. 10, 1934, females (F. E. Lutz); female (E. L. Bell). Fremont Saddle, San Francisco Mountains, Arizona, 11,000 feet, Aug. 12, 1934, male (E. L. Bell).

***Lycosa coloradensis* Banks**

Lycosa coloradensis BANKS, 1894, Jour. New York Ent. Soc., II, p. 50.

RECORD.—Tucson, Arizona, July and Aug., 1934, immature female (P. Steckler).

***Lycosa antelucana* Montgomery**

Lycosa antelucana MONTGOMERY, 1904, Proc. Acad. Nat. Sci. Philadelphia, p. 282, Pl. XVIII, figs. 5, 6.

RECORD.—Supai, Coconino Co., Arizona, Aug. 3, 1934, female (P. E. Geier), Tucson, Arizona, July and Aug., female (P. Steckler).

***Lycosa frondicola* Emerton**

Lycosa frondicola EMERTON, 1885, Trans. Connecticut Acad. Arts and Sci., VI, p. 484, Pl. XLVI, fig. 3.

RECORDS.—Near Aspen Spring, San Francisco Mountains, Arizona, Aug. 10, 1934, female (F. E. Lutz). Flagstaff, Arizona, Aug. 9, 1934, female (E. L. Bell).

***Lycosa gosiuta* Chamberlin**

Lycosa avara var. *gosiuta* CHAMBERLIN, 1908, Proc. Acad. Nat. Sci. Philadelphia, p. 281, Pl. XX, fig. 4.

RECORD.—Kaibab Forest, near North Rim Grand Canyon, Arizona, July 10, 1931, female (Gertsch).

HERSILIIDAE

***Tama mexicana* (Cambridge)**

Hersilia mexicana CAMBRIDGE, 1892, 'Biologia Centralia Americana,' Arachnida-Araneidea, I, p. 107, Pl. XIV, fig. 6.

RECORDS.—Native Palms, Brownsville, Texas, Nov. 3, 1934, two males (S. Mulaik). Brownsville, Texas, July 1, 1934, female (J. N. Knull). Edinburg, Hidalgo Co., Texas, male from mud daubers nest (S. Mulaik). Fifteen miles south of Edinburg, March, 1933, male, females (S. Mulaik).

THERIDIIDAE**Lithyphantes distinctus** (Thorell)

Steatoda distincta THORELL, 1877, Bull. U. S. Geol. Survey, III, p. 485.

RECORD.—South Rim Grand Canyon, Arizona, July 22, 1934, female (E. L. Bell).

Lithyphantes corollatus ((Linnaeus)

Aranea corollata LINNAEUS, 1758, 'Systema Nature,' 10th Ed., p. 621.

RECORDS.—North Rim Grand Canyon, Arizona, July 19, 1934, females (E. L. Bell). South Rim Grand Canyon, Arizona, July 22, 1934, two females (E. L. Bell). Rim of Walnut Canyon, San Francisco Mountains, Arizona, Aug. 18, 1934, seven females (Mr. and Mrs. E. L. Bell). Walnut Canyon, San Francisco Mountains, Arizona, Aug. 18, 1934, female (D. Rockefeller).

Theridion placens Keyserling

Theridion placens KEYSERLING, 1884, 'Die Spinnen Amerikas,' Theridiidae, I, p. 71, Pl. III, fig. 43.

RECORDS.—Near Neal Spring, North Rim Grand Canyon, Arizona, July 18, 1934, male, females (D. Rockefeller and P. E. Geier).

Steatoda grandis Banks

Steatoda grandis BANKS, 1901, Proc. Acad. Nat. Sci. Philadelphia, p. 678.

RECORDS.—South Rim Grand Canyon, Arizona, July 22, 1934, female (E. L. Bell). Walnut Canyon, San Francisco Mountains, Arizona, Aug. 19, 1934, female (E. L. Bell).

Latrodectus mactans (Fabricius)

Aranea mactans FABRICIUS, 1775, 'Entom. Syst.,' II, p. 410, No. 11.

RECORDS.—Supai, Arizona, Aug. 3, 1934, male (P. E. Geier). Rim of Walnut Canyon, San Francisco Mountains, Aug. 18, 1934, immatures (Mr. and Mrs. E. L. Bell). Walnut Canyon, San Francisco Mountains, Arizona, Aug. 19, 1934, immatures (E. L. Bell). Foot of Sunset Crater, San Francisco Mountains, Arizona, Aug. 18, 1934, females (D. Rockefeller).

LEPTONETIDAE**Leptoneta californica** Banks

Figure 11

Leptoneta californica BANKS, 1904, Proc. California Acad. Sci., (3) III, p. 333, Pl. XXXVIII, fig. 11.

RECORD.—A female, presumably this species, from Blackwell, Texas, Aug. 15, 1926 (F. C. Bishopp).

Usofila gracilis Marx

Usofila gracilis MARX, 1891, Proc. Ent. Soc. Washington, II, p. 9, Pl. I, fig. 6.

RECORD.—Mill Creek, Salt Lake City, Utah, Sept. 8, 1930, female (W. J. Gertsch).

LINYPHIIDAE**Linyphia marginata** C. Koch

Linyphia marginata C. KOCH, 1834, Herr. Schaeff. 'Deutsch Ins.,' Heft 127, p. 21.

RECORD.—Near Aspen Spring, San Francisco Mountains, Arizona, Aug. 10, 1934, male (F. E. Lutz).

Linyphia communis Hentz

Linyphia communis HENTZ, 1850, Jour. Boston Soc. Nat. Hist., p. 28, Pl. IV, fig. 4.

RECORD.—Indian Gardens, Grand Canyon, Arizona, July 24, 1934, two females (F. E. Lutz).

Pityohyphantes hesperus (Chamberlin)

Linyphia hespera CHAMBERLIN, 1920, Canadian Entomologist, LI, pp. 194-195, Fig. 19 (sub. 4).

RECORDS.—Near Aspen Spring, San Francisco Mountains, Arizona, Aug. 10, 1934, females (F. E. Lutz); females (D. Rockefeller).

In the southwestern United States the common Holarctic *Pityohyphantes* (*P. phrygiana* C. Koch) is replaced by a closely related species, described as *Linyphia hespera* by Chamberlin. A third species of the genus, *Pityohyphantes* (*Linyphia*) *limitanea* Emerton, a much smaller form, is known from New England and has recently been found to be very common in Alberta, Canada.

ARGIOPIDAE**Leucauge venusta** (Walckenaer)

Epeira venusta WALCKENAER, 1837, 'Insectes Apteres,' II, p. 90.

RECORD.—Supai, Havasu Canyon, Arizona, Aug. 2, 1934, female (F. E. Lutz).

Tetragnatha extensa (Linnaeus)

Araneus extensa LINNAEUS, 1758, 'Systema Naturae,' 10 Ed., I, p. 621.

RECORDS.—Near Neal Spring, North Rim Grand Canyon, Arizona, July 18, 1934, male, two females (D. Rockefeller); two females (P. E. Geier). Near Phantom Ranch, Grand Canyon, Arizona, July 26, 1934, females (E. L. Bell and D. Rockefeller).

Tetragnatha laboriosa (Hentz)

Epeira laboriosa HENTZ, 1850, Jour. Boston Soc. Nat. Hist., VI, p. 27, Pl. iv, fig. 3.

RECORD.—Supai, Navasu Canyon, Arizona, Aug. 2, 1934, immature females (F. E. Lutz).

Argiope trifasciata (Forskål)

Aranea trifasciata FORSKÅL, 1775, 'Descript. Anim.'

RECORD.—Below Phantom Ranch, Grand Canyon, Arizona, July 26, 1934, female (E. L. Bell).

Aranea gemma (McCook)

Epeira gemma MCCOOK, 1888, Proc. Acad. Nat. Sci. Philadelphia, p. 193, Figs. 1, 2.

RECORD.—Aspen Spring, San Francisco Mountains, Arizona, Aug. 10, 1934, female (P. E. Geier).

Aranea displicata (Hentz)

Epeira displicata HENTZ, 1847, Jour. Boston Soc. Nat. Hist., V, p. 476, Pl. xxxi, fig. 17.

RECORD.—Near Neal Spring, Grand Canyon, Arizona, July 18, 1934, female (P. E. Geier)

Neoscona oaxacensis Keyserling

Epeira oaxacensis KEYSERLING, 1863, Sitz-Ber. der Isis zu Dresden, p. 121, Pl. v, figs. 12-16.

RECORD.—Below Phantom Ranch, Grand Canyon, Arizona, July 26, 1934, male, three females (F. E. Lutz).

ZOROPSIDAE**Zorocrates mistus** Cambridge

Zorocrates mistus CAMBRIDGE, 1896, 'Biologia Centralia Americana,' Arachnida-Araneidea, I, p. 176, Pl. xxi, figs. 9, 10.

RECORD. Santa Rosa Valley, Baboquivari Mountains, Arizona, Aug. 12, 1916, immature female (F. E. Lutz).

Zorocrates aemulus, new species

Figures 31 and 32

MALE.—Total length, 5.25 mm. Carapace, 2.75 mm. long, 2.00 mm. wide. Abdomen, 2.25 mm. long, 1.50 mm. wide.

Integument of the carapace dull yellow, sparsely clothed with fine black hairs that form two indistinct dark dorsal bands. Sternum and mouth parts dull yellow; covered

with black hairs. Legs basally dull yellow, distally light brown, clothed with black hairs and armed with strong spines. Abdomen gray, with black markings on the dorsum, the venter unmarked.

Carapace longer than broad, convex, the cephalic part poorly delimited from the thoracic, the median suture longitudinal. Sides well rounded, the pars cephalica weakly constricted at the sides, nearly square in front. First row of eyes narrower than the second, which row is about five-eighths as wide as the carapace at that point. Clypeus half as high as the diameter of an anterior lateral eye. First row of eyes procurved as viewed from in front, equidistantly spaced, the medians somewhat smaller. Eyes of the second row practically straight, subequal, the medians separated by their radius, about a diameter from the laterals. Median ocular quadrangle as broad as long, slightly narrowed in front, the anterior medians slightly smaller. Lateral eyes subequal. Sternum slightly longer than broad (20/17), suboval. Labium four-fifths as broad as long, five-ninths as long as the endites. Lower margin of the furrow of the chelicera armed with three subequal teeth, the upper with three of which the middle one is larger.

Leg formula, 4123. All tarsi scopulate beneath. First two pairs of legs more thickly covered with hairs than the posterior pairs.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	2.42	1.16	2 25	2.12	1 12	9.07 mm.
II	2.08	1.00	1 75	1.75	0 90	7.48 mm.
III	1 75	0.90	1 42	1.75	0 75	6 57 mm.
IV	2.62	1.00	2 31	3 00	1 08	10.01 mm.

Spines. First leg. Femur: dorsal, 1-1-1, prolateral, 1 distal. Tibia: ventral, 2-2-2-2. Metatarsus: ventral, 2-2-2. Elsewhere none. Second leg as first but prolateral spine of femur missing. Third leg. Femur: dorsal, 3-3-3, Patella: prolateral, 1, retrolateral, 1. Tibia: dorsal, prolateral and retrolateral, each 1-1, ventral, 2-2-2. Metatarsus: dorsal, 1-2-2, ventral, 2-2-2, prolateral and retrolateral, each 1-1-1. Fourth leg. Femur: dorsal, 3-4-3. Patella: retrolateral, 1. Tibia: dorsal, prolateral and retrolateral, each 1-1-1, ventral, 2-2-2-2. Metatarsus: dorsal, 1 median, prolateral and retrolateral, each 1-1-1-1, ventral 2-2-2-2.

FEMALE.—Total length, 6.75 mm. Carapace, 3.25 mm. long, 2.75 mm. wide. Abdomen, 3.30 mm. long, 2.00 mm. wide.

Color and structure as in the male, the legs proportionately shorter, the metatarsus and tarsus of the first two legs and the tarsi of the last two pairs scopulate beneath. Calamistrum a band of hairs on the fourth metatarsus, occupying the basal third of the length of the joint. Epigynum as figured.

TYPE LOCALITY.—Male holotype, female allotype, and paratypes of both sexes from one-half mile east of Rio Grande City, Texas, Nov. 11, 1934 (S. Mulaik). Male and female paratypes from thirty-two miles east of Laredo, Texas, Nov. 11, 1934 (S. Mulaik). Male and female paratypes from thirty miles west of Edinburg, Texas, Nov. 24, 1934 (Mulaik, Rutherford and Welch, collectors).

This small species agrees with *Zorocrates pictilis* Simon in having four, rather than the conventional five, pairs of spines beneath the first

tibiae. Miss Bryant of the Museum of Comparative Zoölogy has kindly compared this species with examples of *pictilis* from Lower California and has pronounced them distinct. *Zorocrates pictilis* Simon is a much larger species.

SPARASSIDAE

Olios abnormis Keyserling

Olios abnormis KEYSERLING, 1883, Verh. k.k. Zool.-Bot. Gesell., Wien, XXXIII, p. 679, Pl. XXI, fig. 27.

RECORD.—Kits Peak Rincon, Baboquivari Mountains, Arizona, July 31–Aug. 3, 1916, male (F. E. Lutz).

Olios fasciculatus Simon

Olios fasciculatus SIMON, 1880, Actes Soc. Linn., Bordeaux, XXXIV, p. 307.

RECORDS.—Scottsdale, Arizona, Jan. 3, 1903, females (Britcher). Tucson, Arizona, July and Aug., 1934, females (P. Steckler).

THOMISIDAE

Thanatus peninsulanus Banks

Thanatus peninsulanus BANKS, 1898, Proc. California Acad. Sci., (3) I, p. 265, Pl. xvi, fig. 11.

Thanatus retentus CHAMBERLIN, 1919, Pomona College Jour. Ent. and Zoöl., XII, p. 9, Pl. vi, fig. 5.

RECORD.—Ruins near Tucson, Arizona, July and August, 1934, males, females (P. Steckler).

Tibellus chamberlini Gertsch

Tibellus chamberlini GERTSCH, 1933, American Museum Novitates, No. 593, pp. 10–11, Figs. 7, 8, 9, 14.

RECORDS.—North Rim Grand Canyon, Arizona, July 18, 1934, two males (F. E. Lutz). South Rim Grand Canyon, Arizona, July 22, 1934, female (D. Rockefeller). Near Phantom Ranch, Grand Canyon, Arizona, July, 26, 1934, females (D. Rockefeller and P. E. Geier).

Titanebo mexicanus (Banks)

Ebo mexicanus BANKS, 1898, Proc. California Acad. Sci., (3) I, p. 256, Pl. xvi, fig. 9.

RECORD.—Foot of Sunset Crater, San Francisco Mountains, Arizona, Aug. 18, 1934, female (D. Rockefeller).

***Philodromus alascensis* Keyserling**

Philodromus alascensis KEYSERLING, 1883, Verh. k. k. Zool.-Bot. Gesell., Wien, XXXIII, p. 674, Pl. XXI, fig. 22.

RECORD.—Aspen Spring, San Francisco Mountains, Arizona, Aug. 11, 1934, two immature females (D. Rockefeller).

***Philodromus rufus* Walckenaer**

Philodromus rufus WALCKENAER, 1825, 'Faune Francaise.'

RECORDS.—North Rim Grand Canyon, Arizona, July 18, 1934, female (D. Rockefeller). Aspen Spring, San Francisco Mountains, Arizona, Aug. 10, 1934, female (P. E. Geier).

***Misumena vatia* (Clerck)**

Araneus vatius CLERCK, 1757, 'Svensk. Spindl.,' p. 128, Pl. XI, fig. 5.

RECORD.—Near Neal Spring, North Rim Grand Canyon, Arizona, July 18, 1934, male (P. E. Geier).

***Misumenops oblongus* (Keyserling)**

Misumena oblonga KEYSERLING, 1880, 'Die Spinnen Amerikas,' Laterigradae, (I), p. 79, Pl. II, fig. 41.

Misumena americana KEYSERLING, 1880, idem, p. 85, Pl. II, fig. 45.

RECORD.—Indian Gardens, Grand Canyon, Arizona, July 24, 1934, female (F. E. Lutz).

***Misumenops dubius* (Keyserling)**

Misumena dubia KEYSERLING, 1880, 'Die Spinnen Amerikas,' Laterigradae, (I), p. 90, Pl. II, fig. 48.

RECORD.—Phantom Ranch, Grand Canyon, Arizona, July 26, 1934, female (F. E. Lutz).

***Misumenops coloradensis* Gertsch**

Misumenops coloradensis GERTSCH, 1933, American Museum Novitates, No. 636, p. 17, Figs. 15, 46.

RECORDS.—Bright Angel Spring, North Rim Grand Canyon, Arizona, July 18, 1934, male (D. Rockefeller). Below Phantom Ranch, Grand Canyon, Arizona, July 28, 1934, female (D. Rockefeller). Idem, male (E. L. Bell). South Rim Grand Canyon, Arizona, July 22, 1934, female (D. Rockefeller). Supai, Havasu Canyon, Arizona, Aug. 2, 1934, male, female (F. E. Lutz). Williams, Arizona, Aug. 8, 1934, female (F. E. Lutz).

Xysticus locuples Keyserling

Xysticus locuples KEYSERLING, 1880, 'Die Spinnen Amerikas,' Laterigradae, (I), p. 24, Pl. I, fig. 9.

RECORD.—Near Bright Angel Spring, North Rim Grand Canyon, Arizona, July 18, 1934, female (F. E. Lutz).

Xysticus cunctator Thorell

Xysticus cunctator THORELL, 1877, Bull. U. S. Geol. Survey, III, p. 494.

RECORDS.—Aspen Spring, San Francisco Mountains, Arizona, Aug. 10, 1934, female (E. L. Bell). Fremont Saddle, San Francisco Mountains, Arizona, Aug. 12, 1934, female (E. L. Bell).

Xysticus lutzi, new species

MALE.—Total length, 4.05 mm. Carapace, 2.50 mm. long, 2.42 mm. wide.

Integument of the carapace light brown, heavily masked by irregular dark brown and black maculations, armed with short hairs, a few short, stiff spines and longer spines on the clypeal margin and in the eye region. Dorsum of carapace with an indistinct, median, light band scarcely as wide as the first row of eyes. Ocular area with a transverse creamy-white band which includes the tubercles of both lateral eyes. Posterior declivity with the conventional four large black markings. Sternum, mouth parts and coxae light brown to yellow, spotted with black. Legs lighter brown than the carapace, the distal joints yellow, the basal joints of the first two pairs heavily marked with brown. Abdomen dorsally with a basal and three caudal, indistinct transverse light bands, the venter paler.

Carapace about as broad as long, moderately convex, the sides well rounded, the cephalic portion scarcely half as broad as the greatest width. Cephalic sutures virtually obsolete. Sternum longer than broad (17/15). Labium longer than broad (8/5), more than two-thirds as high as the endites.

Eyes of the first row procurved, the small medians separated by about two diameters, about half as far from the laterals. Eyes of the second row broader than the first (9/7), the smaller medians scarcely two diameters apart, two and one-half diameters from the medians. Median ocular quadrangle longer than broad (7/6), the posterior eyes very slightly larger. Clypeus as high as the diameter of an anterior lateral eye.

Legs provided with black hairs and strong spines. Tibia and metatarsus of the first leg with four pairs of strong ventral spines. First leg: femur, 3.00 mm.; patella, 1.20 mm.; tibia, 2.10 mm.; metatarsus, 2.38 mm.; tarsus, 1.00 mm. long. Tibia and patella of palpus as long as the tarsus, the tibia armed with a lateral and a ventral apophysis. Truncus of embolus a black tube, free of the accessory embolic pars pendula at the distal end of the tarsus, which is strongly curved on the retro-lateral bulbal surface to fit the deeply excavated tutaculum. Processes on the bulb intimately joined at the base, the upper one much smaller than the lower (distal) apophysis. Other details as figured.

TYPE LOCALITY.—Male holotype from Kits Peak Rincon, Baboquivari Mountains, Arizona, July 31–Aug. 3, 1916 (F. E. Lutz).

This species is closely related to the various species of the *cunctator* group, but is easily separated by the much larger median apophysis and the greatly curved embolus, which lacks the terminal accessory process present in those species.

GNAPHOSIDAE

Zelotes subterraneus (C. Koch)

Melanophora subterranea C. KOCH, 1839, 'Die Arachniden,' VI, p. 85, Pl. cci, figs. 491, 492.

RECORD.—Near Aspen Spring, San Francisco Mountains, Arizona, Aug. 10, 1934, females (F. E. Lutz).

Orodassus coloradensis (Emerton)

Drassus coloradensis EMERTON, 1877, Bull. U. S. Geol. Survey, III, p. 528.

RECORDS.—North Rim Grand Canyon, Arizona, July 19, 1934, female (F. E. Lutz). Doyle Saddle between Fremont and Agassiz Peaks, San Francisco Mountains, Arizona, 11,500 feet, Aug. 14, 1934, female (P. E. Geier).

Gnaphosa brumalis Thorell

Gnaphosa brumalis THORELL, 1875, Proc. Boston Soc. Nat. Hist., XVII, p. 497.

RECORD.—Aspen Spring, San Francisco Mountains, Arizona, Aug. 14, 1934, two females (E. L. Bell).

Gnaphosa muscorum (L. Koch)

Pythonissa muscorum L. KOCH, 1866, 'Die Arachnidenfamilie der Drassiden,' Nurnberg.

Gnaphosa gigantea KEYSERLING, 1887, Verh. k. k. Zool.-Bot. Gesell., Wien, XXXVII, p. 424, Pl. vi, fig. 3.

RECORDS.—Near Aspen Spring, San Francisco Mountains, Arizona, Aug. 10, 1934, females (F. E. Lutz); female (E. L. Bell); Aug. 11, 1934, female (D. Rockefeller); Aug. 14, 1934, females (E. L. Bell). Agassiz Peak, San Francisco Mountains, Arizona, 12,300 feet, Aug. 14, 1934, females (F. E. Lutz).

Drassodes neglectus (Keyserling)

Drassus neglectus KEYSERLING, 1887, Verh. k. k. Zool.-Bot. Gesell., Wien, XXXVII, p. 434, Pl. vi, fig. 10.

RECORD.—Fremont Saddle, San Francisco Mountains, Arizona, Aug. 12, 1934, female (F. E. Lutz).

HOMALONYCHIDAE***Homalonychus selenopoides* Marx**

Homalonychus selenopoides MARX, 1891, Proc. Ent. Soc. Washington, II, p. 3, Pl. I, fig. 1.

RECORD.—Scottsdale, Arizona, Jan. 8, 1903, female and immatures (Britcher).

The epigynum of the mature female is practically identical with *Homalonychus theologus* Chamberlin from Lower California.

CLUBIONIDAE***Clubiona obtusa* Emerton**

Clubiona obtusa EMERTON, 1915, Trans. Connecticut Acad. Arts and Sci., XX, p. 153, Pl. III, fig. 4.

RECORD.—Scottsdale, Arizona, December, 1902, male (Britcher).

***Chiracanthium inclusum* (Hentz)**

Clubiona inclusa HENTZ, 1847, Jour. Boston Soc. Nat. Hist., V, p. 451, Pl. XXIII, fig. 18.

RECORD.—Near Phantom Ranch, Grand Canyon, Arizona, July 26, 1934, male (D. Rockefeller).

***Lauricius hemicloeiinus* Simon**

Lauricius hemicloeiinus SIMON, 1888, Ann. Soc. Ent. France, (6) VIII, p. 208.

RECORDS.—Water Camp, Santa Catalina Mountains, Arizona, male, female (Mrs. Westphall). Otero County, New Mexico, Aug., 1934, males, females (S. Mulaik).

SALTICIDAE***Metaphidippus vitis* (Cockerell)**

Dendryphantus vitis COCKERELL, 1894, Entomologist, XXVII, p. 207.

RECORDS.—Near Phantom Ranch, Grand Canyon, Arizona, July 26, 1934, males, females (D. Rockefeller); July 27, 1934, males, females (P. E. Geier).

***Metaphidippus imperialis* (Peckham)**

Attus imperialis PECKHAM, 1888, Trans. Wisconsin Acad. Sci., VII, p. 44, Pl. III, fig. 31.

RECORD.—Supai, Havasu Canyon, Arizona, Aug. 3, 1934, male, female (E. L. Bell).

Pellenes signatus Banks

Habrocestum signatum BANKS, 1900, Canadian Entomologist, XXXII, p. 101.

RECORDS.—Near Phantom Ranch, Grand Canyon, Arizona, July 26, 1934, male, two females (D. Rockefeller); July 27, 1934, male (P. E. Geier).

Habrocestum belli, new species

Figures 38 and 39

MALE.—Total length, 4.50 mm. Carapace, 2.25 mm. long, 1.58 mm. wide.

Integument of the carapace dark brown to black, clothed with a sparse covering of black and white scales and with a few long black hairs that project over the eyes of the first row. Clypeal region and chelicerae dark brown. Sternum and mouth parts dark brown. Integument of the legs light brown, the last three pairs with basal and distal annulac, the first leg mainly dark brown. Abdomen dark brown to black above, without definite pattern, the venter brown to black.

Carapace weakly convex, moderately high (the ratio of height to length being 7:18), broadest behind the third eye row, the sides only slightly convex, the posterior declivity beginning three-fourths of the length behind. First row of eyes recurved, a line along the upper edge of the medians passing through the center of the laterals, which are half as large. Small eyes of the second row midway between the eye rows. Third eye row three fourths as broad as the carapace at that point, nine-tenths as broad as the first row of eyes. Posterior eyes two-thirds as large as the anterior laterals. Eyes occupying about four-fifths of the total length of the carapace. Clypeus one-fifth as high as the diameter of an anterior median eye. Chelicerae slightly excavated on the retrolateral surface, the lower margin of the furrow armed with a single tooth. Sternum scarcely three-fourths as broad as long, bluntly pointed behind, the last coxae subcontiguous, the first coxae separated by their width. Labium longer than broad, half as high as the slightly convergent endites, which are broadest at the distal end.

First leg slightly longer and more robust than the fourth, with a light fringe of black hairs beneath the patella and tibia, the latter joint armed with three pairs of spines, the first pair of which is placed forward one-fourth of the total length from the base, the last pair of spines distal. Palpus as figured.

TYPE LOCALITY.—Male holotype from near Aspen Spring, San Francisco Mountains, Arizona, Aug. 10, 1934 (F. E. Lutz).

This species is apparently congeneric with *Habrocestum morosum* Peckham with which species it has been compared. The palpus compares favorably with *Tylogonus minutus* Cambridge, a Mexican species which differs considerably in color pattern.

ANYPHAENIDAE**Anyphaena crebrispina** Chamberlin

Anyphaena crebrispina CHAMBERLIN, 1919, Pomona College Jour. Ent. and Zoölogy, XII, p. 10, Pl. iv, fig. 4.

RECORD.—Bear Wallow to Mt. Lemon, Santa Catalina Mountains, Arizona, July 13, 1916, male, two females (F. E. Lutz).

Miss Bryant (1931, *Psyche*, XXXVIII, p. 113) has suggested that *A. crebrispina* "is probably the male of *A. californica* (Banks)," but the discovery of authentic females proves it to be a good species. The male of *californica* seems clearly to be *Anyphaena ruens* Chamberlin.

SUBORDER APNEUMONOMORPHAE

CAPONIIDAE

***Orthonops gertschi* Chamberlin**

Figures 33 and 34

Orthonops gertschi CHAMBERLIN, 1928, *Psyche*, XXXV, pp. 235-236.

RECORDS.—Verde River, thirty miles North of Mesa, Arizona, March 14, 1930, female (R. V. Chamberlin). Edinburg, Texas, two females (S. Mulaik). Northwest of Edinburg, Texas, Sept. 3, 1934, female (S. Mulaik). Thirty miles west of Edinburg, Texas, Nov. 24, 1934, male (Rutherford).

***Tarsonops systematicus* Chamberlin**

Figure 35

Tarsonops systematicus CHAMBERLIN, 1924, *Proc. California Acad. Sci.*, (4), p. 601, Fig. 37.

RECORDS.—Northwest of Edinburg, Texas, Sept. 3, 1934, female (S. Mulaik). One-half mile east of Rio Grande City, Texas, Nov. 11, 1934, female (S. Mulaik).

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DESCRIPTIONS OF THE OLDEST KNOWN SOUTH AMERICAN MAMMALS, FROM THE RÍO CHICO FORMATION¹

BY GEORGE GAYLORD SIMPSON

The remarkably full sequence of mammalian faunas of South America has hitherto begun with the *Notostylops* Fauna of the Casamayor Formation of Patagonia. The only reported supposed older mammals were a few isolated specimens, now lost and probably not mammalian, and a single identifiable specimen which, with a few scraps, constituted the "*Proteodidelphys* Fauna" and which proves to be of highly dubious origin and not separable from a species of relatively late (Santa Cruz, probably lowest Miocene) age (see Simpson 1932a). Within the last five years, however, it has been discovered that there is a mammalian fauna immediately below the Casamayor and distinct from its *Notostylops* Fauna. This very important discovery has been announced briefly by Piatnitzky (1931), by Feruglio (1931, based on discoveries by Piatnitzky and by Brandmayr), and by me (1932b, 1933). None of these oldest mammals has been described or named, aside from the passing remarks that "the mammals are very definitely of Tertiary aspect and close to those of the *Notostylops* beds" (Simpson, 1932b, pp. 7-8) and that the formation contains "a fauna or faunal facies of mammals of Tertiary type, principally notoungulates, of very primitive character and small individual size" (Simpson 1933, p. 11). It has now been possible to study most of the known specimens, and they are named and described and their occurrence briefly discussed in the present paper.

Throughout most of Chubut, the Casamayor tuffs and bentonites are underlain by a series of sandstones and clays (mostly bentonites or bentonitic) of very different aspect, previously considered as of Cretaceous age and barren or dinosaur-bearing². As regards the supposed occurrence of dinosaurs here, these are all extremely dubious and it can be affirmed that no dinosaur has ever been found in the middle or upper part of this probably complex series and probably none, in place of original deposit, even in the lower part (Feruglio 1931, p. 21; Simpson 1933b, pp. 4-6). Various names have been applied to this formation.

¹Publications of the Scamitt Expeditions, No. 24.

²In some places the so-called "argiles fissilaires" intervene, but these need not be discussed here.

It is, approximately, Ameghino's "Notostylopense basal," Windhausen's "parte superior de los estratos con dinosaurios," Feruglio's "Pehuenche," Frenguelli's "Sehuenense," etc. I have elsewhere (1933) shown that none of these names can properly be used. "Notostylopense basal," besides the fact that it is not a stratigraphic name (and is also etymologically erroneous) rested wholly on theory—there was no evidence that the beds had anything to do with the "Notostylopense" = Casamayor. It was, in fact, a remarkably shrewd guess, much nearer the truth than most of the work of Ameghino's critical successors, but it was not a correct scientific interpretation of the stratigraphy. The variations on the idea "Upper part of dinosaur beds" not only provide no useful and correct stratigraphic terminology, but are fundamentally wrong in application to beds which do *not* contain dinosaurs. Both Pehuenche and Sehuenense are useful terms, but not in application to this series, as they imply correlations that are probably or surely incorrect. In view of these nomenclatural inadequacies and of the lithologic and faunal peculiarity of the formation in question, I have (1933) named this formation the Río Chico. The mammal-bearing formations previous to the Patagonian marine so far surely distinguished are as follows:

Colhué-Huapi and Trelew (*Colpodon* fauna)
Deseado (*Pyrotherium* fauna)
Musters (*Astraponotus* fauna)
Casamayor (*Notostylops* fauna)
Río Chico (*Kibenikhoria* fauna)

The first four are familiar and were described by Ameghino. The last, still scanty but adequately distinctive, is described here.

It is not impossible that a few of Ameghino's "Notostylopense" specimens were from the Río Chico Formation, but this could now be established only by a process of elimination. If any of his species are found to occur in the Río Chico but are not again found in the Casamayor, presumably they were from the lower beds. At present this has not been found true of any species. A few of the Ameghino specimens are labeled as from sandstones, "areniscas," but as this term was sometimes also applied to the coarser tuffs, the true quartz sandstones are not necessarily indicated. Carlos Ameghino stated to me in 1931 that he did not recall ever finding a fossil in place in the beds now called Río Chico. Ameghino's "Notostylopense inferior" is part of the Casamayor and is not equivalent to or included in the Río Chico.

Roth's *Lelfunia haugi* and *Monolophodon minutus*, hitherto ignored or considered as of Casamayor age, were from beds probably of Río

Chico age. As far as can be definitely established, these are the only Río Chico mammals hitherto described.

The known Río Chico fossils have been collected by Roth, Piatnitzky, Feruglio, Brandmayr, Bordas, and the Scarritt Expeditions. The Scarritt Expeditions (1930-1931 and 1933-1934) material is the chief basis of this paper. The few Roth specimens have also been studied, for which privilege I am much indebted to Dr. Angel Cabrera and to Dr. L. M. Torres, former Director of the Museo de La Plata. Dr. Egidio Feruglio very kindly sent his large and important collection to New York for study, and I am very appreciative of his liberality in permitting its inclusion in this study. Ing. A. Piatnitzky gave us much assistance in the field, and first indicated to us the important Cañadón Hondo locality. Ing. J. Brandmayr accompanied me to the Bajo de la Palangana and also gave stratigraphic data on that area. I also wish to thank Sr. Carlos Ameghino for unpublished data on the magnificent Casamayor collection made by him, Dr. M. Doello Jurado for the privilege of studying the Ameghino Collection, now in his charge, and Sr. A. F. Bordas for assistance in this connection. Without the detailed knowledge of the Casamayor fauna made possible by this coöperation, the true character of the Río Chico material could not be established.

The accompanying drawings are by Mildred Clemens.

The present paper is confined to the description of specimens, but will be immediately followed by another in which data as to stratigraphy and localities are given and the general nature and correlation of the fauna discussed.

Although catalogue numbers have not yet been assigned to them, the specimens from the Feruglio Collection here described have been presented to the University of Padua, Italy, where they will be permanently preserved.¹ Casts of all these specimens are in the American Museum, and for the exact specification of types the catalogue numbers of these casts are given.

MARSUPIALIA

BORHYAENIDAE

PATENE,² new genus

TYPE.—*Patene coluapiensis*, new species.

DISTRIBUTION.—Río Chico and Casamayor Formations, Patagonia.

DIAGNOSIS.—Borhyaenids of medium to small size, with upper molars of very primitive type. Paracone present on M⁻³ only slightly smaller than and well separated from metacone. Paracone and metacone nearly external on M¹⁻², nearly

¹The description of, and still more the founding of species on, specimens privately owned should, I think, be universally condemned.

²*Patene* "for," Tehuelche. With few exceptions I have compounded the names of the oldest South American mammals from the oldest language of the area in which they occur.

median on M^3 . Increasingly great metastylar spur on M^{1-3} , on M^3 projecting strongly posteriorly. Distinct style external to and separate from paracone on M^{1-2} . Protocone large on all molars. M^{1-3} with small, distinct proto- and metaconules. M^4 as wide as M^3 , with strong parastylar spur, paracone median, metacone represented by a basal cuspule, tooth still distinctly molariform.

***Patene coluapiensis*,¹ new species**

TYPE.—Amer. Mus. No. 28448, part of right maxilla with M^{1-4} . Found by C. S. Williams.

HORIZON AND LOCALITY.—Lowest fossil horizon, Casamayor Formation, barranca south of Lago Colhué-Huapi, Chubut, Argentina.

DIAGNOSIS.—Only known definable species of genus. Length M^{1-4} , 24.5 mm.

Although not from the Río Chico, this interesting genus and species are here published in order to list *Patene* in the Río Chico fauna without publishing a *nomen nudum*. A full description, with illustrations, has been prepared and will be published later. *Patene* is one of the most primitive, and is the oldest, of known borhyaenid genera. In the Río Chico it is represented at present only by a single broken upper molar, Amer. Mus. No. 28532, from Cañadón Hondo. This differs somewhat from *P. coluapiensis*, but so slightly as to warrant the tentative conclusion that it belongs to the same genus. The specimen is inadequate to define a species.

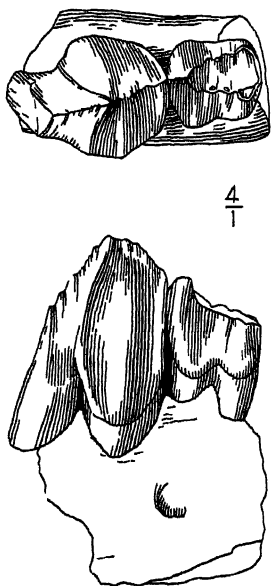


Fig. 1. *Polydolops winecage*, new species. Type, Feruglio Collection. Left lower jaw with M_{1-2} . Crown and external views, enlarged four diameters.

POLYDOLOPIDAE

***Polydolops winecage*,² new species**

TYPE.—In Feruglio Collection, part of left lower jaw with M_1 and M_2 . Cast, Amer. Mus. No. 27893.

HORIZON AND LOCALITY.—About six meters below the lowest true ash bed of the Casamayor, Bajo de la Palangana, Chubut, Argentina.³

DIAGNOSIS.— M_1 length 4.5 mm., width 4.0 mm. M_2 length 3.2 mm., width 2.8 mm. General structure close to *P. thomasi*, but M_1 considerably wider relative to its length, and M_2 much smaller both absolutely and relative to M_1 .

P. crassus has M_1 even wider relative to its length and M_2 is much larger, *P. serra* has

¹*Coluapi*, an abbreviated form and the usual pronunciation of the Aisauanian name *Colu-uapi*, now usually written Colhué-Huapi.

²*Winecage*, "eight." Tehuelche. This is the eighth species to be referred to this genus.

³For more detailed horizon and locality data of this and all other specimens described in this paper see the next paper of this series.

a smaller and more slender M_1 and a larger M_2 , and *P. clavulus* is smaller.

?*Polydolops kamektsen*,¹ new species

TYPE.—Amer. Mus. No. 28525. Part of right lower jaw with M_3 .

HORIZON AND LOCALITY.—Río Chico Formation, Cañadón Hondo, Chubut, Argentina.

DIAGNOSIS.— M_3 very small, length 2.4 mm. and width 2.0 mm. in type, rounded oval in contour, trigonid narrower than talonid.

This is intermediate between *P. clavulus* and *P. serra* in size, and not close enough to either to be possibly synonymous. It is morphologically so distinctive that it probably belongs to a new genus, but the specimen is inadequate for definitive decision on this point. M_2 (as indicated by alveoli) was considerably smaller than in *P. winerage*.

***SEUMADIA*,² new genus**

TYPE.—*Seumadia yapa*, new species.

DIAGNOSIS.— M^1 triangular, slightly wider than long, the corners somewhat elevated but without any distinct cusps. Crown very low, with a very shallow basin, with numerous irregular, anastomosing small grooves and ridges.

The proportions and the cusp structure, or its absence, sharply distinguish this from the homologous tooth of *Polydolops*. The proportions may have been more nearly similar in *Pliodolops*, in which M^1 is not yet known, but M^3 of that genus has strong, definite cusps and could hardly have been associated with an M^1 like that of *Seumadia*. *Amphidolops* has similarly wrinkled enamel and small cusps, but the cusps (also in the upper teeth, as suggested by an M^3 probably of this genus, in our collection), while small, are numerous, sharp, and distinct, and the crowns are rather high although the apical pattern is shallow. No other genus suggests comparison.

The genus is surely distinct, and is named even though the material is so limited, because of the great interest in this form which belongs to the oldest South American faunule.

¹*Kamektsen* (also sometimes written *Kamektsen*, *Kamektsen*, *Kamektsen*, and *humanakoutsen*), "nine," Tehuelche. This is the ninth species to be referred to this genus.

²*Seu(na)*, "many," *mad*, "valley," Tehuelche, in allusion to the innumerable anastomosing grooves on the crown.

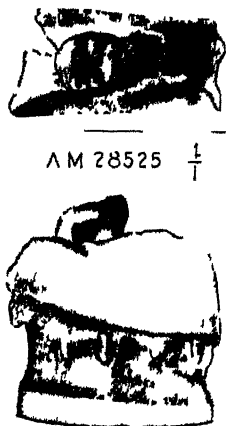


Fig. 2. ?*Polydolops kamektsen*, new species. Type, Amer. Mus. No. 28525. Part of right lower jaw with M_3 . Crown and external views, enlarged four diameters.



AM 28431

Fig. 3. *Seumadia yapa*, new genus and species. Type, Amor. Mus. No. 28431. Isolated M^4 . Crown view, enlarged four diameters.

Seumadia yapa,¹ new species

TYPE.—Amor. Mus. No. 28431, isolated M^4 .

HORIZON AND LOCALITY.—Rio Chico Formation, 37 meters above the "Banco Verde" of the Salamanca, Cerro Redondo, west of Puerto Visser, Chubut, Argentina.

DIAGNOSIS.—Sole known species of the genus. M^4 measures 3.4 mm. in length and 3.6 mm. in width.

FAMILY UNCERTAIN

Gashternia,² new genus

TYPE.—*Gashternia talehor*, new species.

DISTRIBUTION.—As for the sole species.

DIAGNOSIS.—Metaconid higher than and directly internal to protoconid. Paraconid conical, anteroexternal to metaconid, smaller than metaconid and basally confluent with it. Anterior wing of protoconid crescent, at least on M_{27} running to anterior border at its median point and not to the paraconid. Talonid about equal in size to trigonid and hypoconid about as high as protoconid. Entoconid posterointernal, somewhat elongate anteroposteriorly. Apparently no hypoconulid.

The type jaw has two teeth which appear to be M_{1-2} but could be P_4-M_1 . The more anterior tooth is slightly broken, but on it the paraconid was apparently larger, nearer the protoconid and farther from the metaconid, and the peculiar anterior protoconid wing was less developed or absent.



A.M. 28533

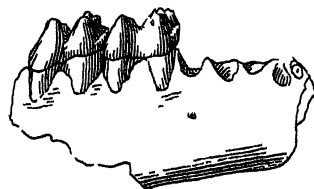
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Fig. 4. *Gashternia talehor*, new genus and species. Type, Amer. Mus. No. 28533. Right lower jaw with two teeth. Crown and external views, enlarged two diameters.

Alveoli indicate that there was a large, semi-procumbent canine, followed by a very small, one-rooted, crowded P_1 , a larger two-rooted P_2 , closely crowded and planted obliquely so that its anterior root is posteroexternal to that of P_1 , and a still larger two-rooted P_3 .

This peculiar little jaw is quite unlike anything else known to me. It clearly is not a notoungulate, and while it could conceivably be a condylarth or litoptern-like animal, it is too unlike any other known to warrant such a theory of relationships. There is some suggestion

that it may be marsupial, chiefly the fact that the probabilities somewhat favor the presence of only three premolars, but this is not certain.

¹*Yapa*, "little," Tehuelche.

²*Gashtern*, "deep," Tehuelche = *Hondo* in Spanish, from the locality

The molars are as much like those of some marsupials as like any other group, although not enough to prove relationships. *Caroloameghinia* is remotely similar, but very different in detail, with separate entoconid and hypoconulid, distinct metastylid, etc. Comparison with any caenolestoids is excluded not only by the somewhat different molar structure, but also by the character of the premolar roots and the large canine.

***Gashternia ctalehor*,¹ new species**

TYPE.—AMER. MUS. NO. 28533. Part of right lower jaw with two cheek teeth and several alveoli.

HORIZON AND LOCALITY.—Río Chico Formation, Cañadón Hondo, Chubut, Argentina

DIAGNOSIS.—Sole known species of genus. First tooth of type, length 4.9 mm. width 3.2 mm., second tooth, length 5.0 mm., width 3.5 mm.

CONDYLARTHRA

DIDOLODONTIDAE

***Ernestokokenia yirunhor*²**

TYPE.—AMER. MUS. NO. 28539, part of right lower jaw with M_{2-3} .

HORIZON AND LOCALITY.—Río Chico Formation, Cañadón Hondo, Chubut, Argentina.

DIAGNOSIS.—A didolodontid with very simple teeth, smaller than any species previously referred to *Ernestokokenia* and larger than any known species of *Asmithwoodwardia*. M_2 , length 6.2 mm., width 4.8 mm.; M_3 , length 6.9 mm., width 4.7 mm.

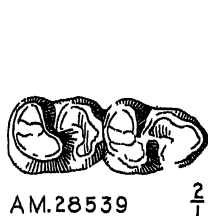


Fig. 5

Fig. 5. *Ernestokokenia yirunhor*, new species. Type, Amer. Mus. No. 28539. Right M_{2-1} . Crown view, enlarged two diameters.



4/1

Fig. 6

Fig. 6. *Ernestokokenia yirunhor*. Doubtfully referred specimen in Feruglio Collection. Right M_2 and left M_3 . Crown views, enlarged four diameters.

Ameghino's genera *Asmithwoodwardia*, *Ernestokokenia* (including the upper teeth named *Notoprotogonia*), and *Archaeohyracotherium* are separated by only the most trivial structural details and can be retained

¹*Ctale(nc)*, "small," *hor*, "tooth," Tehuelche.

²*Yirun*, "hill," *hor*, "tooth," Tehuelche, from the very bunodont teeth.

as separable at all only because the type species are distinct and the genera may prove to be so when more than isolated teeth are known. Incomplete as it is, this specimen is the best of this group yet found. Its generic assignation is, of course, unclear since it is also a very distinct species and the supposed generic differences are so minor and variable, but on the whole it seems most satisfactory to place it in *Ernestokokenia*.

In the Feruglio Collection from the upper sandstone of the Bajo de la Palangana there is an M_3 , measuring 6.6 by 4.7 mm., which is probably of this species. In the same lot is an M^3 also possibly of this species. Except for characters clearly due to its being a last molar, this tooth is closely similar to those of other species of *Ernestokokenia* ("*Notoprotopogonia*"), but indicates a smaller animal, length 5.4 mm., width 6.7 mm. (Casts, Amer. Mus. No. 27896.)

***Ernestokokenia chaishoer*,¹ new species**

TYPE.—In Feruglio Collection, isolated upper molar, probably M^3 . Cast, Amer. Mus. No. 27892a.

PARATYPE.—In Feruglio Collection, isolated lower molar, probably M_2 . Cast, Amer. Mus. No. 27892b.

HORIZON AND LOCALITY.—About six meters below lowest true tuff of the Casamayor, Bajo de la Palangana, Chubut, Argentina.

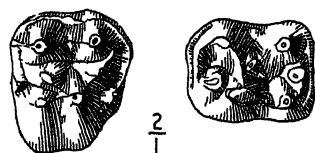


Fig. 7. *Ernestokokenia chaishoer*, new species. Type and paratype, in Feruglio Collection. Right ? M^3 and right ? M_2 . Crown views, enlarged two diameters.

DIAGNOSIS.— M^{*2} longer relative to width than known teeth of *E. patagonica* or *E. trigonalis* and somewhat larger. No cingulum across protocone or hypocone, but continuous, sharp external cingulum. Much larger than *Archaeohyracotherium mediale*. M_2 larger than *E. nitida* and with small cusp on hypoconid-metaconid crest, as in *Didolodus*, trigonid and talonid of equal width. M^{*2} length 7.9, width 9.4 mm. M_{*2} length 8.2, width 6.4 mm.

The lower molar is with difficulty distinguishable from an as yet unnamed Lower Casamayor species of *Didolodus*, but the upper molar, having no mesostyle, obviously is not of *Didolodus*. As the two teeth are from the same horizon and locality, are harmonious in structure, and occlude well, it is proper to assume that they are of the same species. As already suggested, the generic division of this group is as yet very unsatisfactory. It is also unlikely that this robust species is really of the same genus as the diminutive teeth from the same locality referred to *E. yirunhor* (above), but the material

¹*Chaish*, "large," *oer* (or *hor*), "tooth," Tehuelche. (Musters gives *chaish* and *oer*; Schmid, *clsaín* and *hor*).

is inadequate for generic revision and it seems most conservative to retain these similar forms in *Ernestokenia* for the present.

LITOPTERNA

?PROTROTHERIIDAE

WAINKA,¹ new genus

TYPE.—*Wainka tshotshe*, new species.

DISTRIBUTION.—As for the species.

DIAGNOSIS.—Upper molar resembling *Ricardolydekkeria* in general structure, but paracone and metacone heavy, very close together, bases connate, and no trace of a mesostyle.

The tooth is heavier and more transverse than the type of *Ricardolydekkeria praerupta*, with the conules more distinct, somewhat more as in *Josepholeidya*, the metaconule somewhat larger and better separated from the protocone. The protostyle, or anterointernal cingulum cusp, is well developed and about as in *Ricardolydekkeria*, and the hypocone, or posterointernal cingulum cusp, is considerably smaller. The parastyle is strongly developed, also much as in *Ricardolydekkeria*, but there is a sharp, well-marked, continuous external cingulum and no trace of mesostyle or median external fold.

Although known only from one tooth, the genus is very distinctive and merits a name as one of the two oldest known South American mammals. Many isolated teeth of this general type are known from later beds, but all have strong mesostyles² and other, less-marked distinctions. The affinities of *Wainka* are apparently with this group, *Josepholeidya*, *Ricardolydekkeria*, etc., very tentatively placed in the Proterotheriidae pending discovery of associated material which may determine the affinities more closely.

Wainka tshotshe³

TYPE.—Amer. Mus. No. 28505, isolated left upper molar (M¹ or M²).

HORIZON AND LOCALITY.—Río Chico Formation, 37 meters above the "Banco Verde" of the Salamanca, on Cerro Redondo west of Puerto Visser, Chubut, Argentina.

DIAGNOSIS.—Sole known species of genus. Length of type 8.9 mm., width 12.8 mm.

A lower tooth, left M₃, from the same horizon and locality, Amer. Mus. No. 29101, may represent this genus and perhaps also this species. Its size and structure are compatible with *Wainka tshotshe*, and it re-

¹*Wainc* or *Waink*, Tehuelche, "old."

²Ameghino's figures of *Josepholeidya adunca* give the impression that the mesostyle is weak or absent, but it is broken on the specimen and was strong when undamaged.

³*Choche* or *tshotshe*, Tehuelche, "one."

sembles *Anisolambda* (which I believe to be the lower dentition of *Josepholeidya*, *Ricardolydekkeria*, or both) to about the same degree as *Wainka* resembles *Ricardolydekkeria*. The tooth measures 14.6 mm. by approximately 8 mm. (slightly broken). The general structure is as in *Anisolambda*, but the paraconid is slightly more external and is almost completely conical, being connected neither to the metaconid nor to the anterior crest from the protoconid. The latter crest does not curve as directly inward as in *Anisolambda*, but runs more forward and then turns internally at nearly a right angle. The hypoconulid projects very strongly, much more than in any species of *Anisolambda* and there is a

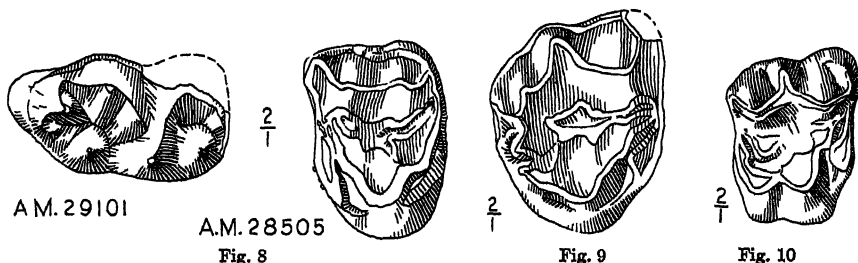


Fig. 8. *Wainka tshotshe*, new genus and species. Type, Amer. Mus. No. 85205, and referred specimen, Amer. Mus. No. 29101. Left upper molar and left M_3 . Crown views, enlarged two diameters.

Fig. 9. ?*Victorlemoinea* species. Feruglio Collection. Right M_3 . Crown view, enlarged two diameters.

Fig. 10. *Josepholeidya* species. Feruglio Collection. Right upper molar. Crown view, enlarged two diameters.

shelf, with sharp, denticulate rim, between and internal to it and the isolated, conical entoconid. The talonid, at least (broken off on the trigonid), has a sharp, continuous, but narrow external cingulum.

VICTORLEMOINEA sp.

An M_3 in the Feruglio Collection from the upper sandstone in the Bajo de la Palangana apparently represents this genus, and is about the size of *V. emarginata*, but M_3 of the latter species is not known and no exact comparison can be made. (Cast, Amer. Mus. No. 27895.)

JOSEPHOLEIDYA sp.

A tooth of the same origin as that just mentioned, suggests *J. adunca*, but again proper comparison is impossible. (Cast, Amer. Mus. No. 27890.)

RICARDOLYDEKKERIA sp.

Another tooth of the same origin resembles *R. cinctula* sufficiently for reference to the same genus. It is probably a distinct species, but is inadequate for secure definition. (Cast, Amer. Mus. No. 27891.)

?LITOPTERNA indet.

Amer. Mus. No. 28572 from Cañadón Hondo is the inner half of a worn upper molar. Although it is, of course, inadequate for identification, it definitely suggests *Guilielmofloweria*, and with some probability belongs to the same general group.



Fig. 11



Fig. 12



A.M. 28555

Fig. 13

Fig. 11. *Ricardolydekkeria* species. Feruglio Collection. Right upper molar. Crown view, enlarged two diameters.

Fig. 12. *?Peripantostylops orehor*, new species. Type, Amer. Mus. No. 28526. Left M^2 . Crown view. Enlarged two diameters.

Fig. 13. *?Peripantostylops orehor*, new species. Paratype, Amer. Mus. No. 28555. Left lower jaw with M_{1-3} . Crown and internal views, enlarged two diameters.

NOTOUNGULATA**NOTIOPROGONIA****HENRICOSBORNIIDAE****?Peripantostylops orehor,¹ new species**

TYPE.—Amer. Mus. No. 28526, part of left maxilla with M^2 .

PARATYPE.—Amer. Mus. No. 28555, part of left lower jaw with M_{1-3} .

HORIZON AND LOCALITY.—Río Chico Formation, Cañadón Hondo, Chubut, Argentina.

DIAGNOSIS.— M^2 resembling *P. minutus* in relatively strong crochet, deep valley, etc., but larger, more transverse, and crochet weakly forked at end. Paratype lower

¹*Ore(nc)*, "white," *hor*, "tooth," Tehuelche—the comparative Casamayor specimen happening to have deeply stained teeth.

teeth also slightly larger and relatively markedly more transverse, more strongly built, internal valleys less open, more distinct internal cingulum on metaconid. Measurements as below:

M ²		M ₁		M ₂		M ₃	
Length	Width	Length	Width	Length	Width	Length	Width
4.8	6.8	4.2	3.3	5.1	3.8	5.6	3.6

This is probably a distinct genus, but it is almost impossible to distinguish these small henricosborniids generically without much better material than is yet available.¹ The type and paratype are not associated and there is inevitably some doubt as to their really being of the same species, but the characters are so harmonious and the occlusion so perfect that their tentative union is fully warranted.

***Henricosbornia waitehor*,² new species**

TYPE.—Amer. Mus. No. 28530, part of left lower jaw with M₁₋₂ and part of M₃.

HORIZON AND LOCALITY.—Río Chico Formation, Cañadón Hondo, Chubut, Argentina.



A.M. 28530

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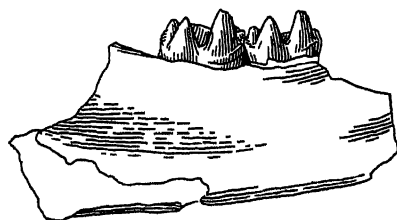


Fig. 14. *Henricosbornia waitehor*, new species. Type, Amer. Mus. No. 28530. Left lower jaw with M₁₋₂. Crown and internal views, enlarged two diameters.

DIAGNOSIS.—Closely similar to *H. lophodonta*, but lower molars narrower relative to length and metaconids slightly weaker, less produced anteriorly or antero-externally. Measurements as follows:

M ₁		M ₂	
Length	Width	Length	Width
5+	3.7	5.5	3.8

¹We have, however, good associated upper and lower dentitions of the Casamayor *Peripantostylops minutus* which place this species on a better basis than any other of the family.

²*Waite*(no), "yellow," *hor*, "tooth," Tehuelche.

It is extremely difficult to distinguish genera, and sometimes even families, in these very stereotyped lower molars of primitive notoungulates, but this is so close to *Henricosbornia lophodonta* in structure that its correct reference to this genus is highly probable.

?POSTPITHECUS sp.

A fragmentary lower jaw, with M_3 , in the Feruglio Collection (Cast, Amer. Mus. No. 27888), from the upper sandstone of the Bajo de la Palagana, may belong to *Postpithecus*. The heel crest is single, without separate cusps, and there is no transverse entoconid crest. There is a small spur or accessory cuspule on the metaconid. M_3 is not surely known in *Postpithecus*, but might be like this. The size would be about right for *P. reflexus*. An M_3 referred to *P. curvicrista* by Ameghino (figured but not the type) is similar but has the heel more irregular in outline and the entoconid more separate, although not transverse. It is also smaller.



Fig. 15. ?*Postpithecus* sp. Feruglio Collection. Left M_3 . Crown view, enlarged two diameters.

There is an M^3 from the same place which occludes well with the M_3 discussed in the last paragraph, although good occlusion does not necessarily prove identity. The upper tooth is apparently a henricosborniid, but is not exactly like any other M^3 known to me. The lower tooth is so unusual that its reference to the henricosborniids is very dubious.¹

?NOTOSTYLOPIDAE

Gen. et sp. indet.

Amer. Mus. No. 28556, from Cañadón Hondo, is an isolated upper molar, probably M^2 , which is unlike any other known to me but is too doubtful in character to warrant more than a passing note. A little larger than *Henricosbornia lophodonta*, it differs in the flattened ectoloph posterior to the paracone fold, in the small and subordinate hypocone, and in the flattened inner wall without a definite groove between protocone and hypocone. These are all notostyloid characters. On the other hand its very small size (length 6.1, width 7.7 mm.), slight but continuous and oblique crochet basally united with the ectoloph, and relatively low crown are all unlike any known notostyloid. Comparison with *Seu-denius cteronc* cannot be very detailed, but the crown is relatively a little higher and the species is considerably smaller.

¹It is by no means certain that *Postpithecus* is correctly placed in this family.

?NOTIOPROGONIA incertae sedis

SEUDENIUS,¹ new genus

TYPE.—*Seudenius cleronc*, new species.

DISTRIBUTION.—As for the species.

DIAGNOSIS.—A primitive notoungulate with extremely low-crowned teeth. P^{2,4} very short and wide, P³ with convex outer wall and small separate parastyle fold. Protocone of P⁴ attached to protoloph but not to metaloph. Small posterointernal cingulum but no hypocone on P⁴. M¹ quadrate, with fairly prominent metacone fold and slightly basined external cingulum between this and paracone fold. M² trapezoidal, metacone fold absent or very weak, external cingulum distinct, hypocone small and not strongly united to protocone. Valleys of P³–M² not forming closed fossettes, or these obliterated immediately by wear.

There are three specimens of this peculiar genus in the collection, but all are very imperfect. They show that the genus is very distinctive and demand designation, but do not permit any close determination of affinities. There are resemblances to three different families (and suborders), but in no case is the resemblance close enough to demonstrate special relationship. There is some resemblance to the most primitive isotemnids, such as *Marschlosseria*,² but the simpler premolars, very low crowns, and absence or very early obliteration of closed fossettes are distinctly non-isotemnid characters. There is also some resemblance to the larger henricosborniids, but here, too, the very simple and transverse premolars are different from any known genus, as are also the ectoloph wall of M¹ and, especially, M², and also the proportions of protocone to hypocone on M². The species is also much larger than any known henricosborniid. Finally, there is a strong suggestion of the more primitive notostylopids, especially *Homalostylops parvus*, which is of about the same size, but the crowns are still lower in *Seudenius*, P⁴ is still simpler than in *Homalostylops*, the lack of a protocone-metaloph connection on the premolars is distinctive, and there are other minor differences. Presumably *Seudenius* belongs to one of these three groups, perhaps with slightly greater probability to one of the latter two, but the discovery of completely unworn molars or of the anterior dentition is necessary to determine the question.

Seudenius cleronc is of about the same size as its associate *Kibenikhorria get*, but the two cannot be confused after more than the most superficial examination.

¹*Seu*(no), "many," *den*, "brother," Tehuelche, is allusion to its puzzling resemblance to various different groups.

²Which, however, is aberrant and not surely isotemnid.

Seudenius cteronc,¹ new species

TYPE.—Amer. Mus. No. 28538, part of left maxilla with P³-M², somewhat broken.

HORIZON AND LOCALITY.—Río Chico Formation, Cañadón Hondo, Chubut, Argentina.

DIAGNOSIS.—Sole known species of the genus. P³ length 3.9 mm.; M² length 7.2, width 9.1 mm.

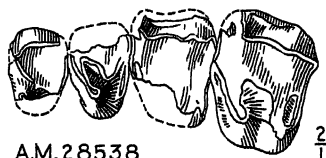


Fig. 16

Fig. 16. *Seudenius cteronc*, new genus and species. Type, Amer. Mus. No. 28538. Left P³-M². Crown view enlarged two diameters.



A.M. 28568

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Fig. 17. *?Isotemnus ctalego*, new species. Type, Amer. Mus. No. 28568. Part of right lower jaw with M²⁻³. Crown and internal views, enlarged two diameters.

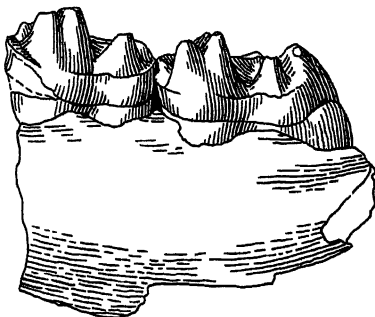


Fig. 17

ENTELONYCHIA**ISOTEMNIDAE****?Isotemnus ctalego,² new species**

TYPE.—Amer. Mus. No. 28568, part of right lower jaw with M¹⁻⁴.

HORIZON AND LOCALITY.—Río Chico Formation, Cañadón Hondo, Chubut, Argentina.

DIAGNOSIS.—Lower molars very low-crowned, small, and primitive. Entoconid nearly conical, transverse cresting very slight. Faint external and internal cingula. Hypoconulids slightly distinct in talonid crescent. M₂ length 10+, width 7.7; M₃ length 12.4, width 7.7 mm.

This species belongs, by definition, to Ameghino's "*Eochalicotherium*," which is almost surely the lower dentition of *Isotemnus*. The

¹*Cteronc*, "bad," Tehuelche.

²*Ctale(nc)*, "little," *go*, "brother," Tehuelche.

species is, on the whole, the most primitive known. "*Trimerostephanus*" *colhuehuapiensis* is of about the same size, but the molars are narrower; the only known specimen is so poorly preserved that the structural details cannot be made out. "*Eochalicotherium*" *minutum* is smaller and still more primitive, but it certainly does not belong in this generic group and probably not in this family.

Amer. Mus. No. 28576, also from Cañadón Hondo, is a fragment of upper jaw with parts of P^4 and M^1 . It also is a very primitive isotemnid, suggesting *Isotemnus enecatus* but still smaller, about the size of *I. apicatus*, with which, however, detailed structural comparison cannot be made on the basis of the known material. Amer. Mus. No. 28576 may represent the upper dentition of ?*Isotemnus ctalego*, and tends to confirm, although it does not prove, reference to this genus.

ISOTEMNIDAE indet.

The presence of other isotemnids at Cañadón Hondo is revealed by a worn lower molar 10.3 mm. in length and by about half of an M^3 of a larger animal. Both are low crowned and suggest very primitive members of this family.

TYPOTHERIA

NOTOPITHECIDAE

?TRANSPITHECUS sp.

Amer. Mus. No. 28578, from Cañadón Hondo, is a maxillary fragment with M^1 and half of M^2 which suggests *Transpithecus* but is inadequate for certain identification.

Gen. et sp. indet.

An isolated upper tooth and several lower teeth and jaw fragments suggest that one or two other notopithecids were present at Cañadón Hondo, but none can now be identified even as to genus.

ACOELODIDAE

KIBENIKHORIA,¹ new genus

TYPE.—*Kibenikhoria get*, new species.

DISTRIBUTION.—As for species.

DIAGNOSIS.—A probable acoelodid close to *Ultrapithecus* but with P^1 two-rooted and longer than wide, P^2 simpler than P^{3-4} and not developing a closed fossette except possibly a very small one in the last stages of wear, P^{1-3} generally less transverse, external metacone fold present on molars and only slightly less prominent than para-

¹*Kibenik* (*c'benic*), "high," *hor*, "tooth," Tehuelche.

cone fold, a sharp pocket developed in the ectoloph between these, and hypocone equal to or smaller than protocone and not projecting so far internally as in *Ultrapiithecus*. Agrees with *Ultrapiithecus* and differs from *Oldfieldthomasia* in absence of metacone fold on premolars and of mesostyle on molars. Crown relatively high for this fauna.

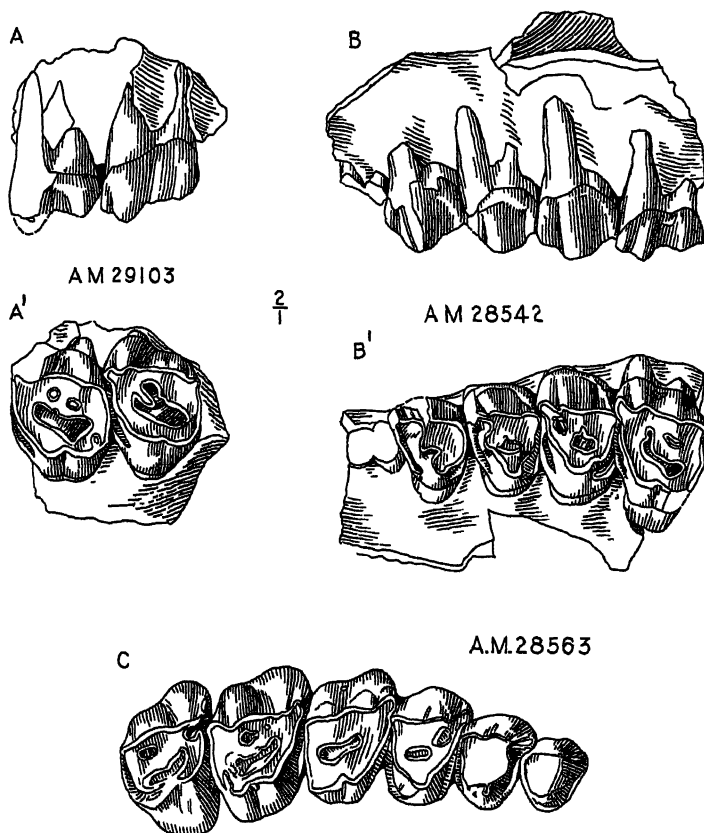


Fig. 18. *Kibenikhorja get*, new genus and species. A, A', referred specimens, Amer. Mus. No. 29103, left M^{2-3} . B, B', type, Amer. Mus. No. 28542, left P^2-M^1 . C, paratype, Amer. Mus. No. 28563, P^2-M^3 . Crown (A', B', C) and external (A, B) views, all enlarged two diameters.

This genus also resembles the probably isotemnid *Mazschlosseria*, especially *M. emundata* (*Isotemnus emundatus* Ameghino), but is probably less closely related to it than to *Ultrapiithecus*. The molar metacone fold is much more prominent, the crowns are higher, the enamel invagina-

tions seem to be somewhat different, and there are other apparent differences difficult to confirm because of the poor material of *Maxschlosseria*.

Isolated lower teeth or jaw fragments with two or three teeth which are almost surely of *Kibenikhoria* also occur in the collection. They seem to be highly variable, but this is probably due to the different wear stages and to the fact that most of them are broken or crushed. As in the upper teeth, the crowns are higher than in other members of this fauna. The hypoconulid is small and appears as a small spur. The

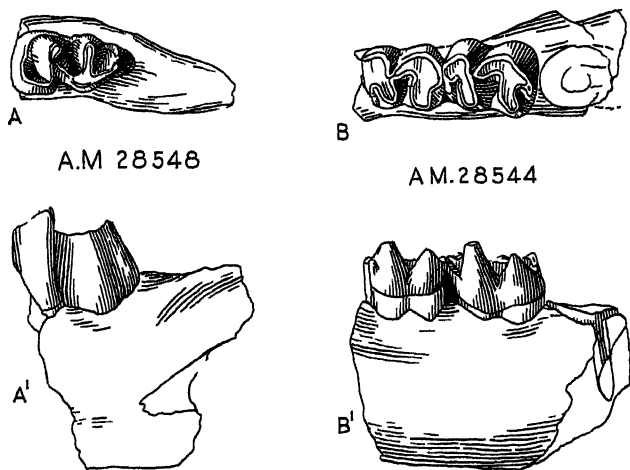


Fig. 19. *Kibenikhoria get*, new genus and species. Referred specimens. A, A', Amer. Mus. No. 28548, left M₃. B, B', Amer. Mus. No. 28544, right M₁₋₂. Crown (A, B), external (A') and internal (B') views, all enlarged two diameters.

entoconid forms a large and plump transverse crest and the valley between this and the expanded metaconid is deep and narrow. The hypoconid crescent abuts against the middle of the protolophid, from which its apex is free although the bases are completely fused. The metaconid is simple even when only slightly worn.

There are also several symphyses, without tooth crowns, in the collection, such as Amer. Mus. No. 28552, which probably belong to this genus, judging from their abundance, size, and general character. They are long and slender, I₁ to C all strongly procumbent and arranged in a narrow parabola, the roots increasing constantly in size from I₁ to C.

Kibenikhoris get,¹ new species

TYPE.—Amer. Mus. No. 28542, part of left maxilla with P²–M¹ and roots of P¹.

PARATYPE.—Amer. Mus. No. 28563, part of right maxilla with P²–M³, worn and in part corroded.

HORIZON AND LOCALITY.—Río Chico Formation, Cañadón Hondo, Chubut, Argentina.

DIAGNOSIS.—Sole known species of genus. Measurements of type as follows:

P ²		P ³		P ⁴		M ¹	
Length	Width	Length	Width	Length	Width	Length	Width
5.2	6.3	...	7.1	5.5	8.3	6.3	8.3

This is far the most common species in the collection, about half the identifiable specimens belonging to it. Among the lower jaw fragments referred are Amer. Mus. No. 28544, with right M₁₋₂, referred with almost complete assurance, and Amer. Mus. Nos. 28548 and 28543, each with a left M₃, referred with some doubt. The last mentioned specimen has a conical cuspule between the entoconid and metaconid which is probably adventitious as it does not appear on other last lower molars otherwise identical.

?TRIGONOSTYLOPOIDEA**Shecenia,**² new genus

TYPE.—*Shecenia stirneri*, new species.

HORIZON AND LOCALITY.—Río Chico Formation, Cañadón Hondo, Chubut, Argentina.

DIAGNOSIS.—Symphysis very long, fused, channeled above, lower surface plane transversely and gently curved longitudinally, meeting the lateral surfaces at a sharp angle. Median teeth small, followed by an also median but more posterior, larger pair. Lateral to these two pairs of teeth is a greatly enlarged, long-rooted, strongly curved, procumbent pair. These are followed by a long, crested diastema, and then (at about the middle of the symphysis) by a somewhat smaller, short-rooted, semi-procumbent pair of teeth.

This cannot be an animal represented by cheek teeth from this locality, for the only cheek teeth of comparable size are fairly orthodox isotemniids that could never have had such a symphysis.

The only genus with which comparison is possible is *Trigonostylops*. They agree in the long, fused symphysis, the presence of two pairs of small incisors enclosed by a pair of greatly enlarged, curving, procumbent teeth posterior to which is a diastema, and (in some species of *Trigonostylops*) the presence of a tooth in the middle of this diastema and (longitudinally) of the symphysis. A tentative suggestion of relation-

¹Get, "fino, nice," Tehuelche.

²Shecen, "chin," Tehuelche, the type being a mandibular symphysis.

ship is warranted. But the peculiar flattening of the lower surface of the symphysis in *Shecenia* is not seen in *Trigonostylops*, and the tooth ($P_{7,1}$) in the diastema of *Shecenia* is large and semi-procumbent while in *Trigonostylops*, if present at all, it is small and vertical. *Shecenia ctirneru* is much smaller than any known species of *Trigonostylops*.

***Shecenia ctirneru*,¹ new species**

TYPE.—Amer. Mus. No. 28531, mandibular symphysis with various alveoli and roots or worn bases of one pair of teeth.

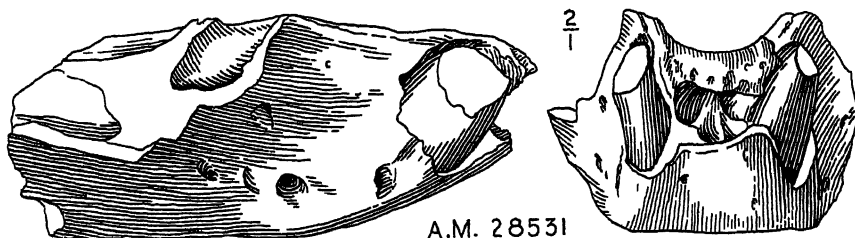


Fig. 20. *Shecenia ctirneru*, new genus and species. Type, Amer. Mus. No. 28531. Mandibular symphysis. Right lateral and anterior views, enlarged two diameters.

HORIZON AND LOCALITY.—Río Chico Formation, Cañadón Hondo, Chubut, Argentina.

DIAGNOSIS.—Sole known species of genus. Width of flat lower surface of symphysis 13.5 mm. Length of anterior diastema 10 mm. Maximum diameter of bases of largest pair of teeth 6.2 mm.

Incertae Sedis

***CARODNIA*,² new genus**

TYPE.—*Carodnia feruglioi*, new species.

DISTRIBUTION.—As for the species.

DIAGNOSIS.— M_3 with trigonid bearing a very strong transverse crest, concave anteriorly, rising to a cusp at each end. Crenulated crest curving from protoconid around anteroexternal border and ending at midline, but no distinct paraconid. Talonid lower, simple, without closed basin, slightly narrower and longer than trigonid but not prolonged into a third lobe. Hypoconid separate, nearly conical but prolonged transversely to join a low vague longitudinal crest slightly external to the midline. This vague crest ends posteriorly in an elevated cusp, presumably the hypoconulid, nearly as high as the metaconid but smaller, which is likewise the starting point of a high, sharp, crenulated crest around the posterointernal border of the tooth, ending abruptly and leaving a large, open notch between it and the metaconid.

¹*Ctirne*, "long," *eru*, "head," Tehuelche.

²*Carodn*, "thunder," Tehuelche. This is much the largest animal known from the Río Chico Formation.

Entoconid not represented except as a slightly more prominent eminence near the anterior end of this crest.

The shearing trigonid crest (worn on its posterior edge) resembles that of *Carolozittelia* almost to the point of identity, but the talonid is so different that it is hard to believe in any close relationship. In M_3 of *Carolozittelia* there is a transverse talonid crest very similar to that of the trigonid but slightly smaller, followed by a small third lobe.

Trigonostylops also has a transversely crested trigonid, but it retains a short, but more distinct, anterior wing of the primitive trigonid crescent, and the heel of M_3 is very different. *Griphodon* likewise has a similar trigonid. Its M_3 is unknown, but it is probably a pyrothere and its wide geographic separation and probably different age (as well as the considerably larger size of the known species) do not permit the assumption of any intimate relationship.

Carodnia resembles the primitive uuntathere *Probathyopsis* more closely than any other animal known to me. The trigonid crests are almost identical in structure, and, still more important since here the resemblance to South American groups ceases, the talonid is also basically similar. The hypoconid occupies the same position in both and is similarly isolated except for feeble transverse extension and connection with an imperfect longitudinal eminence. A similar papillated crest runs between hypoconulid and hypoconid in both. The differences are that in *Probathyopsis* the weak anterior crest from the inner side of the hypoconid runs obliquely to the base of the metaconid rather than more longitudinally to near the middle of the base of the protoconid-metaconid crest, that the entoconid is more distinct, the crest from the hypoconulid becoming low against the entoconid base, and that the talonid is longer, the hypoconulid projecting more posteriorly. *Carodnia feruglioi* is larger than *Probathyopsis praecursor*.

M_3 of *Carodnia* is closer morphologically to that of *Probathyopsis* than to any other known form, and it is quite possible that a real rela-

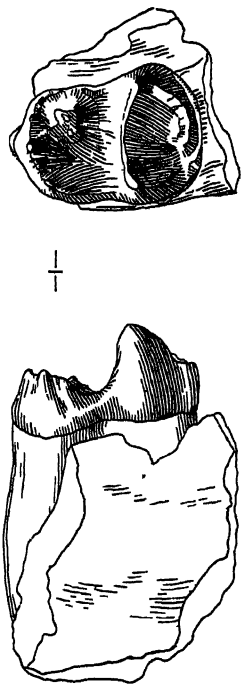


Fig. 21. *Carodnia feruglioi*, new genus and species. Type, Feruglio Collection. Left M_3 . Crown and internal views, natural size.

tionship exists but the inadequate material and the existence of some distinct and possibly important differences do not permit any positive conclusion.

***Carodnia feruglioi*,¹ new species**

TYPE.—In Feruglio Collection, left M₃. Cast, Amer. Mus. No. 27886.

HORIZON AND LOCALITY.—Lower Río Chico Formation, Bajo de la Palangana, Chubut, Argentina.

DIAGNOSIS.—Sole known species of genus. M₃ length 24.3 mm., width of trigonid 17.5 mm., width of talonid 15.5 mm.

***Ctalecarodnia*,² new genus**

TYPE.—*Ctalecarodnia cabrerai*, new species.

DISTRIBUTION.—As for the species.

DIAGNOSIS.—Lower molars consisting of two slightly oblique transverse crests, each elevated into a cusp at each end and somewhat concave on anterior side, an open transverse valley between the crests, the posterior crest slightly smaller, and followed by a median posterior cingulum, about half as wide as the main crests, which forms a much smaller basal crest. Probable P₄ with talonid crest relatively smaller and trigonid quadrate, a ridge running downward and forward from each terminal cusp, that from the metaconid more vague and ending before reaching the anterior margin, that from the protoconid turning at right angles at the anteroexternal corner, continuing as a sharp, low, horizontal ridge along the anterior border, and terminating abruptly near the anterointernal corner.

This animal is represented by a number of tooth fragments, principally the posterior parts of two molars and most of a probable posterior premolar. It is not absolutely certain that these are of one individual, but the probability is so great as to warrant that assumption. They are of appropriate size and structure to belong together and were found at the same horizon and locality in a formation otherwise almost without fossils. They are much too small to belong to *Carodnia feruglioi*. While direct comparison with *Carodnia* is impossible, it is hardly conceivable that two animals so different in size and living in the same area at the same time belong to the same genus, and it also seems highly unlikely that *Carodnia* had M₁ or M₂ similar to those of *Ctalecarodnia*.

The molars of *Ctalecarodnia* do not resemble those of *Probathyopsis*, the talonids, especially, being too different to warrant any idea of special relationship. If *Ctalecarodnia* is related to *Carodnia* (which is quite undemonstrated but conceivable), then *Carodnia* is probably not related to *Probathyopsis*, but such highly hypothetical considerations have little value. *Ctalecarodnia* is also very unlike *Trigonostylops* in talonid

¹Dr. Egidio Feruglio, who found the specimen and who has done so much excellent work in Patagonia.

²*Ctale(nc)*, "small," Tehuelche, + *Carodnia*.

structure. In spite of its very much smaller size, it is closely similar to the same parts of *Carolozittelia* (in which, however, no premolar is known, and the usually distinctive M_3 cannot be compared because unknown in

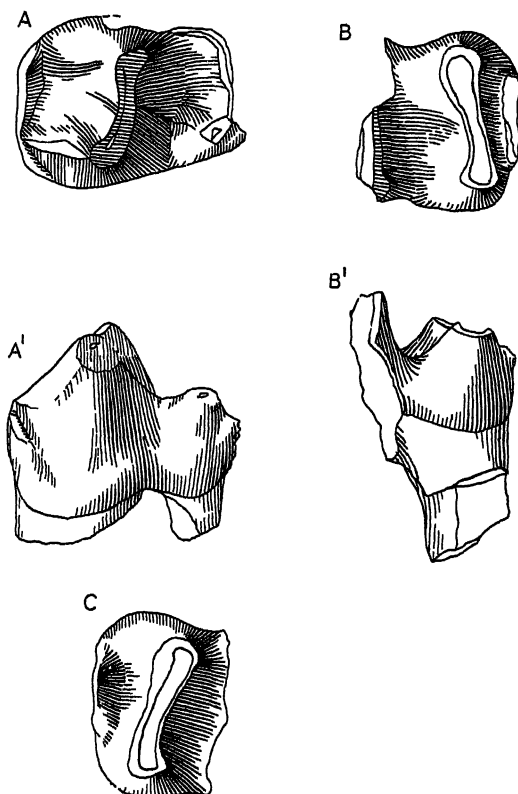


Fig. 22. *Ctalecarodnia cabrerai*, new genus and species. Type, Feruglio Collection. A, A', left ? P_4 . B, B', talonid and part of trigonid of right lower molar. C, talonid of left lower molar. Crown (A, B, C), external (A'), and internal (B') views, enlarged two diameters.

Ctalecarodnia). To a less extent it is also like *Griphodon* in the molars, but the presumable premolar is very unlike either P_3 or P_4 of *Griphodon*. There is resemblance in varying degree to many lophiodont groups, tapirs, kangaroos, sirenians, and so on, but there is no reason to assume the possibility of relationship with any of these on present evidence.

Ctalecarodnia cabrerai,¹ new species

TYPE.—In Feruglio Collection, several probably associated tooth fragments. If it should prove that the association is not natural, the probable posterior premolar is to be taken as the type. Casts, Amer. Mus. No. 27897.

HORIZON AND LOCALITY.—Lower Río Chico Formation, Bajo de la Palangana, Chubut, Argentina.

DIAGNOSIS.—Sole known species of genus. Talonid widths of two more complete molar fragments 11.4 and 11.7 mm. Trigonid width of ?P₄ about 12.2 mm.

Gen. et sp. indet.

At the same horizon and locality as the type of *Carodnia feruglioi* an incisor was found (Fig. 23) which may belong to that species (cast, Amer. Mus. No. 27894). Near this site and about one meter higher was

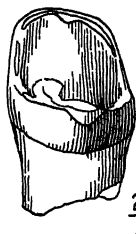


Fig. 23



Fig. 24

Fig. 23. Incisor found with type of *Carodnia feruglioi*. Feruglio Collection. Lingual view, enlarged two diameters.

Fig. 24. Incisor found near to but about one meter higher than type of *Carodnia feruglioi*. Feruglio Collection. Lingual and lateral views, natural size.

found another, somewhat similar but apparently not homologous incisor (Fig. 24. Cast, Amer. Mus. No. 27889), a small incisor or canine surely not of *Carodnia*, and a molar fragment of size appropriate to belong to *Carodnia*, although there is no basis for assumption that it is in fact that genus. (Cast, Amer. Mus. No. 27887.) This is part of a transverse talonid crest followed by a posterior cingulum. It is, of course, too fragmentary to draw any useful conclusion, but the fragment is closely similar to the corresponding part of *Carolozittelia tapiroides*. As already shown, *Carodnia* is certainly not very close to *Carolozittelia*, although some degree of relationship is not wholly excluded.

¹Dr. Angel Cabrera, outstanding authority on Argentine mammals, recent and fossil.

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FURTHER NOTES ON AMERICAN LYCOSIDAE

By W. J. GERTSCH AND H. K. WALLACE

PARDOSA C. Koch

It seems clear that Emerton's *Pardosa pallida* is the same as *Lycosa distincta* Blackwall, described from eastern Canada in 1846. The species is one of the dominant forms of the genus in New England and eastern Canada, where it is abundant in grassy meadows. Until recently there were no published records of the species from the West, but it is now known to be common in the Rocky Mountains in suitable situations, usually at elevations between five and eight thousand feet. In Utah both sexes were found associated with females described as *utahensis* by Chamberlin, and these latter were thought only to be variants from the normal. The discovery of an authentic male of *Pardosa utahensis*, however, lends more weight to the value of small differences in the epigynum as an index of specificity and proves erroneous the synonymizing of the name with *distincta* Blackwall (Gertsch, 1934, American Museum Novitates, No. 693, pp. 23-24). In order to facilitate the recognition and separation of these two species, figures are given in this paper. In addition, two other species which have never been illustrated, *Pardosa yavapa* Chamberlin and *P. montgomeryi* Gertsch, quite as closely allied in color pattern and genitalic structure, are figured for comparison.

Pardosa distincta (Blackwall)

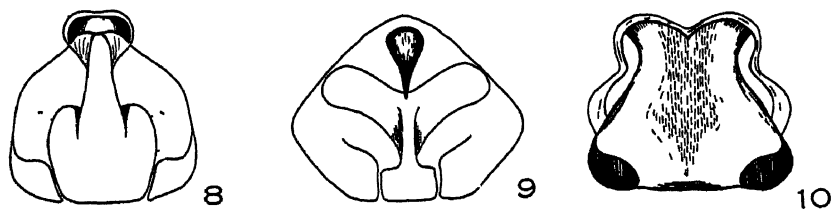
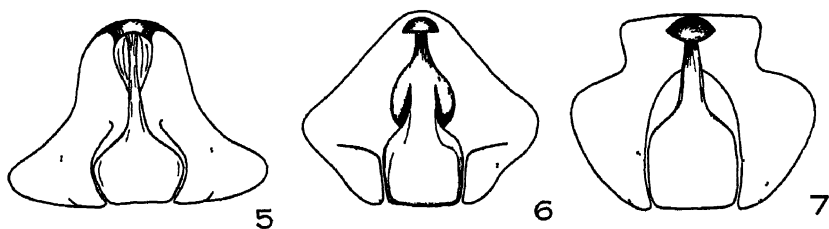
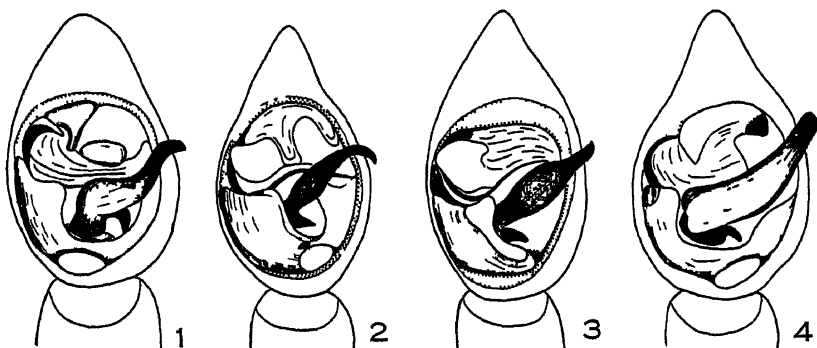
Figures 4 and 8

Lycosa distincta BLACKWALL, 1846, Annals and Magazine Natural History, London, XVII, p. 32.

Pardosa pallida EMERTON, 1885, Trans. Connecticut Acad. Arts and Sciences, VI, p. 496, Pl. XLIX, fig. 3.

Pardosa emertoni CHAMBERLIN, 1904, Canadian Entomologist, XXXVI, p. 175. (New name for *pallida* Emerton, preoccupied.)

DISTRIBUTION.—Eastern Canada. Alberta. New England. Northern Mississippi Basin. Rocky Mountains from Montana to Arizona and New Mexico.



1. *Pardosa montgomeryi* Gertsch, palpus.
2. *Pardosa yavapa* Chamberlin, palpus.
3. *Pardosa utahensis* Chamberlin, palpus.
4. *Pardosa distincta* (Blackwall), palpus.
5. *Pardosa montgomeryi* Gertsch, epigynum.
6. *Pardosa yavapa* Chamberlin, epigynum.
7. *Pardosa utahensis* Chamberlin, epigynum.
8. *Pardosa distincta* (Blackwall), epigynum.
9. *Pardosa yavapa* Chamberlin, abnormal epigynum.
10. *Pardosa andersoni* Gertsch, epigynum.

***Pardosa utahensis* Chamberlin**

Figures 3 and 7

Pardosa utahensis CHAMBERLIN, 1919, Annals Entomological Society of America, XII, p. 258, Pl. XIX, fig. 11.

DISTRIBUTION.—Utah. Colorado. Arizona. New Mexico.

***Pardosa yavapa* Chamberlin**

Figures 2, 6 and 9

Pardosa yavapa CHAMBERLIN, 1925, Bull. Museum of Comparative Zoölogy, LXVIII, pp. 231–232.

Pardosa sanuisana CHAMBERLIN, 1928, Canadian Entomologist, LX, pp. 94–95.

Pardosa orophila GERTSCH, 1933, American Museum Novitates, No. 636, p. 28, fig. 45.

DISTRIBUTION.—Utah. Colorado. Arizona. New Mexico.

***Pardosa montgomeryi* Gertsch**

Figures 1 and 5

Pardosa montgomeryi GERTSCH, 1934, American Museum Novitates, No. 693, pp. 24–25.

DISTRIBUTION.—Texas. New Mexico (Otero County).

Pardosa bellona Banks is typical of another group of species so like each other that difficulty is experienced in their separation. Some of these were discussed by Gertsch in 1934, but no figures were included. It seems to us that *bellona* has been correctly identified and that the two cited records from Utah and Arizona are actually representative of the species. A closely allied species from Texas is described as new in this paper. The study of this group of five species has convinced us that it would be safer to withhold the synonymizing of *Pardosa pauxilla* Montgomery with *uncatula* Cambridge until comparison can be made with authentic Mexican examples of the latter species.

***Pardosa bellona* Banks**

Figure 14

Pardosa bellona BANKS, 1898, Proc. California Academy of Sciences, (3) I, p. 275, Pl. XVI, fig. 21.

DISTRIBUTION.—Mexico. Utah. Arizona.

***Pardosa delicata* Gertsch**

Figure 18

Pardosa delicata GERTSCH, 1934, American Museum Novitates, No. 693, pp. 20–21.

DISTRIBUTION.—La Zacualpa, Chiapas, Mexico.

***Pardosa delicatula*, new species**

Figures 13 and 17

MALE.—Total length, 4.50 mm. Carapace, 2.60 mm. long, 1.90 mm. wide.

Carapace yellowish brown, the sides with a narrow marginal black seam, usually made up of spots, the dorsum with two longitudinal black stripes that may be nearly confluent or that may be well separated to leave an irregular median pale stripe that goes forward to the last eye row. Sides with a submarginal light band that runs to the sides of the head and includes the clypeus. Eye region black. Sternum pale yellowish-brown, margined in black or sometimes with two median stripes. Legs strongly annulate on a pale base. Palpus thickly clothed with black hairs. Dorsum of abdomen gray to black, with an irregular pale longitudinal band made up of spots or in dark specimens with only a light basal hastate maculation. Venter light yellow.

Eyes of the first row slightly procurved, the larger medians separated by a radius, half as far from the laterals. Clypeus twice as high as the diameter of an anterior median eye. Second row of eyes broader than the first (35/22), separated by scarcely a diameter, farther from the eyes of the third row (15/11). Posterior eyes separated by three diameters, smaller than the eyes of the second row (10/14). Dorsal eye quadrangle broader than long (43/30), narrowed in front. Head portion broad, the width at the posterior eye row being two-thirds the greatest width. Sternum longer than broad (6/5). Lower margin of the furrow of the chelicera with three teeth. Palpus, figure 13.

Legs, 4123, the first tibiae with a basal and submedian pair of strong spines and a weak distal pair.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	1.75	0.80	1.61	1.70	1.10	6.96 mm.
II	1.75	0.80	1.50	1.70	1.05	6.80 mm.
III	1.75	0.80	1.40	1.82	0.95	6.72 mm.
IV	2.40	0.90	2.10	3.10	1.30	9.80 mm.

FEMALE.—Total length, 4.75 mm. Carapace, 2.60 mm. long, 1.85 mm. wide.

Structure essentially as in the male. Color usually much lighter but the pattern is in complete agreement with light-colored males. The epigynum (Fig. 17) is closely related to other species of the group and is best separated by a comparison of figures. The proportions of the median apophysis of the palpus in the male will separate it from *bellona*.

TYPE LOCALITY.—Male holotype, female allotype, and numerous paratypes of both sexes from Edinburg, Texas, collected by Mr. Stanley Mulaik, in the collection of The American Museum of Natural History.

***Pardosa pauxilla* Montgomery**

Figures 11 and 15

Pardosa pauxilla MONTGOMERY, 1904, Proc. Acad. Nat. Sci. Philadelphia, p. 268, Pl. XIX, figs. 22 and 23.

DISTRIBUTION.—Texas. Oklahoma.

***Pardosa milvina* (Hentz)**

Figures 19 and 20

Lycosa milvina HENTZ, 1844, Jour. Boston Soc. Nat. Hist., IV, p. 392, Pl. XVIII, fig. 8.

DISTRIBUTION.—Canada. Eastern United States.

***Pardosa floridana* Banks**

Figures 12 and 16

Pardosa littoralis BANKS, 1896, Journal New York Entomological Society, IV, p. 192.

Pardosa floridana BANKS, 1904, Proc. Acad. Nat. Sci. Philadelphia, p. 136, Pl. VII, fig. 1, Pl. VIII, fig. 15.

Pardosa banksi CHAMBERLIN, 1904, Canadian Entomologist, XXXVI, p. 175. (New name for *littoralis* Banks, preoccupied.)

DISTRIBUTION.—Long Island, New York to Florida. Cuba.

Arctosa* C. Koch**Arctosa trifida* F. Cambridge**

Arctosa trifida F. CAMBRIDGE, 1902, 'Biologia Centrali-Americana,' Araneidea, II, p. 330, Pl. XXXI, figs. 24 and 25.

DISTRIBUTION.—Mexico. Southern Texas.

This species is closely allied to *Arctosa littoralis* (Hentz) but differs in the details of the median apophysis of the bulb of the palpus and in having the tibia and patella of the fourth leg as long as, but not longer than, the length of the carapace.

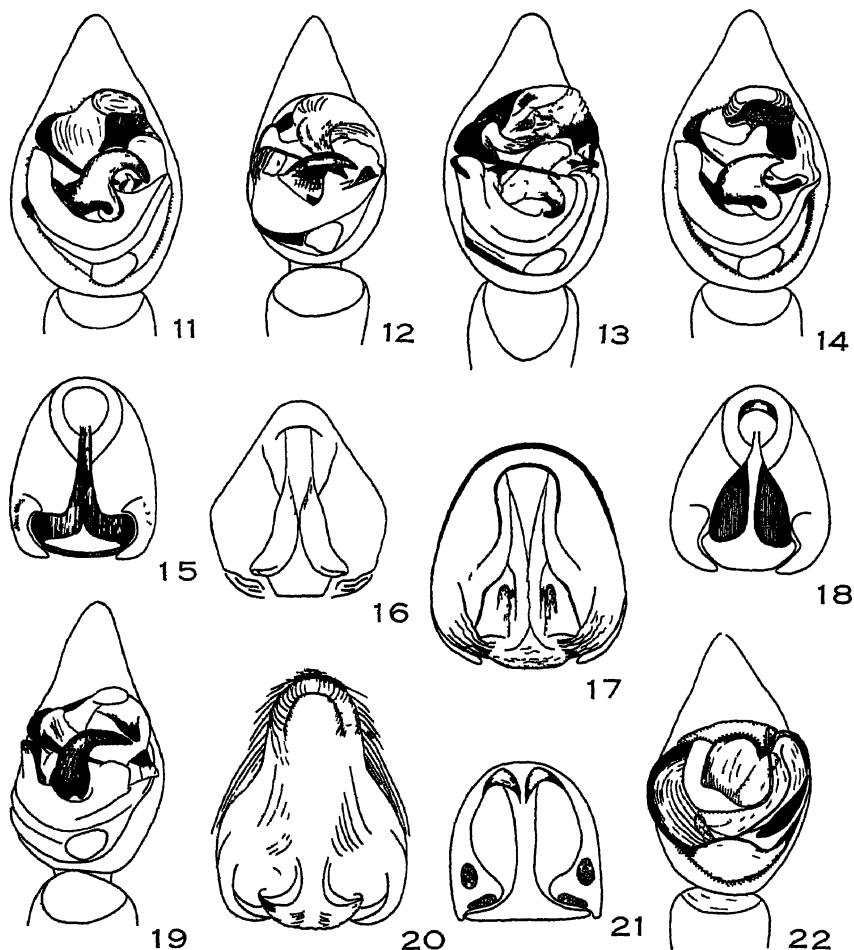
***Arctosa sanctae-rosae*, new species**

Figures 23 and 24

MALE.—Total length, 9.8 mm., not including the spinnerets.

Color of legs and body mainly ivory-white. Abdomen snow-white, flocculent in appearance, the dorsum with a darker basal hastate maculation, the venter somewhat lighter than the sides. Metatarsi and tarsi of legs I and II pale brown, the claws black. Chelicerae and tarsi of the palpi faintly brown. Spines of the legs and claws of the chelicerae dark brown. Posterior eyes incompletely surrounded by a black area, which extends between the eyes of the second row. Scopulae on the anterior margin of the labium, on the endites, and on the furrow of the chelicerae dark brown.

Carapace longer than broad (5.50 mm./4.00 mm.), moderately high (3.00 mm.). Posterior eye quadrangle wider than long (19/14), the anterior eyes slightly larger than the posteriors. Anterior row of eyes narrower than the second row (10/15), straight, the medians nearly twice as large as the laterals, the medians closer to the laterals than to each other. Clypeus about half as high as the diameter of an anterior lateral eye. Chelicerae 2.60 mm. long, exclusive of the claw, 2.10 mm. wide immediately below the clypeus. Lower margin of the furrow of the chelicerae armed with



11. *Pardosa pauxilla* Montgomery, palpus.
12. *Pardosa floridana* Banks, palpus.
13. *Pardosa delicatula*, new species, palpus.
14. *Pardosa bellona* Banks, palpus.
15. *Pardosa pauxilla* Montgomery, epigynum.
16. *Pardosa floridana* Banks, epigynum.
17. *Pardosa delicatula*, new species, epigynum.
18. *Pardosa delicata* Gertsch, epigynum.
19. *Pardosa milvina* (Hentz), palpus.
20. *Pardosa milvina* (Hentz), epigynum.
21. *Schizocosa unica*, new species, epigynum.
22. *Schizocosa unica*, new species, palpus.

three medium-sized teeth, equal in size and equally spaced, the upper margin with three unequal teeth, unequally spaced, the median the largest. Labium slightly longer than broad. Sternum longer than wide (2.80 mm./2.20 mm.). Palpus, figure 23. Anterior spinnerets slightly more than twice as long as the posterior pair, the terminal joint of the anterior pair 0.70 mm. long, the basal joint 0.20 mm. long.

Legs, 4321, all tibiae armed beneath with three pairs of spines, the distal pair apical, less than half as long as the proximal and middle pairs, the middle pair nearer the proximal than the distal pair. All tibiae armed above with a single spine near the middle. Basal spines on the tibiae above replaced by long, hairlike bristles. Femora armed with spines above. Tibia and patella I, 5.80 mm. long, IV, 6.60 mm. long.

FEMALE.—Total length, 10.60 mm., not including the spinnerets.

Color of the legs and body the same as in the male except that the metatarsi and tarsi of legs I and II and the tarsi of the palpi are lighter.

Carapace longer than broad (4.80 mm./3.20 mm.), moderately high (2.60 mm.). Dorsal eye quadrangle wider than long (17/13), the anterior eyes slightly larger than the posteriors. Anterior row of eyes narrower than the second row (10/13), straight, the medians about twice as large as the laterals, the medians closer to the laterals than to each other. Clypeus scarcely as high as the diameter of an anterior lateral eye. Chelicerae, 2.30 mm. long, exclusive of the claw, 1.90 mm. wide immediately below the clypeus. Lower margin of the furrow of the chelicerae armed with three medium-sized teeth, equal in size and equally spaced, the upper margin with three unequal teeth, unequally spaced, the median the largest. Labium slightly longer than wide. Sternum longer than wide (22/18). Epigynum comparatively small, 0.50 mm. wide, figure 24. Anterior spinnerets slightly more than twice as long as the posterior pair, the terminal joint of the anterior pair 0.70 mm. long, the basal joint 0.30 mm. long.

Legs, 4321, the spines similar to those of the male. Tibia and patella I, 4.50 mm. long, IV, 5.60 mm. long.

TYPE LOCALITY.—Male holotype, female allotype and paratypes of both sexes from Santa Rosa Island, Pensacola, Florida, taken April 5, 1934, by H. K. Wallace, the types in the collection of The American Museum of Natural History, some of the paratypes in the collection of H. K. Wallace.

This fine species can be confused with no other from the United States. Some specimens of *Arctosa littoralis* (Hentz) might conceivably approach the ivory-white color of this species, but they can then be separated by the shorter legs and the distinctive trifold median apophysis of the palpus.

PIRATA Sundevall

***Pirata seminola*, new species**

Figures 33 and 35

FEMALE.—Total length, 3.40 mm. Carapace, 1.75 mm. long, 1.20 mm. wide.

Carapace black, the sides with a submarginal light stripe and a narrow marginal black seam, the dorsum with the conventional Y-shaped light marking, the stem por-

tion of the figure going to the caudal margin. Sternum yellowish brown, narrowly margined in black. Labium, endites and coxae yellowish brown. Legs strongly annulate in black on a yellowish base. Dorsum of abdomen mostly black, with a basal lighter hastate maculation and small white spots in the caudal half. Sides of the abdomen concolorous with the dorsum, the venter paler, with an irregular median black stripe.

First row of eyes as broad as the second, very weakly procurved, the larger medians (14/9) separated by their radius, subcontiguous or scarcely separated from the laterals. Eyes of the second row narrower than the third in the ratio 57:77, separated by more than half a diameter (17/23), about one diameter from the posterior eyes, which are separated by three diameters and are somewhat smaller than the laterals (19/23). Dorsal ocular quadrangle broader than long (77/50), narrower in front. Clypeus as high as the diameter of an anterior lateral eye. Second row of eyes seven-tenths of the width of the carapace at that point. Lower margin of the furrow of the chelicera with three subequal teeth. Sternum longer than broad (6/5). Epigynum, figure 33.

Legs, 4123, the tibiae of the first two legs with two ventral pairs and a single spine on the prolateral side, the distals lacking. Last tibia above with a basal and submedian spine.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	1.10	0.50	0.87	0.85	0.42	3.74 mm.
II	1.00	0.50	0.75	0.80	0.40	3.45 mm.
III	1.00	0.45	0.65	0.82	0.37	3.29 mm.
IV	1.35	0.55	1.20	1.40	0.60	5.10 mm.

MALE.—Total length, 3.25 mm. Carapace, 1.80 mm. long, 1.25 mm. wide.

Color and structure essentially as in the female. Male palpus (Fig. 35) very similar to that of *Pirata minuta* Emerton but with the median apophysis proportionately larger.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	1.15	0.55	1.00	1.05	0.50	4.25 mm.
II	1.15	0.55	0.87	0.87	0.47	3.91 mm.
III	1.12	0.42	0.65	0.95	0.40	3.54 mm.
IV	1.50	0.60	1.25	1.50	0.60	5.45 mm.

TYPE LOCALITY.—Male holotype, female allotype, and paratypes from Levy Lake, Florida, March 14, 1934 (H. K. Wallace). Female paratype from Spring Creek, Lake County, Florida, November 4, 1933 (H. K. Wallace). Types in the collection of The American Museum of Natural History.

This small species differs from *Pirata minuta* Emerton in having distinct submarginal pale bands on the carapace, banded legs, and in the comparatively broader pars cephalica.

***Pirata alachua*, new species**

Figures 34 and 36

FEMALE.—Total length, 4.00 mm. Carapace, 2.10 mm., long, 1.50 mm. wide.

Carapace light yellowish-brown, the sides with a broad, light marginal band, the dorsum with the conventional Y-shaped light marking, the intervals between the light stripes infuscated. Most of eye region black. Sternum, mouth parts and coxae yellowish brown. Legs slightly infuscated, without bands or markings. Dorsum of abdomen with a basal hastate light marking and several light spots, otherwise gray, the venter pale yellowish-brown.

First row of eyes six-sevenths as broad as the second, very weakly procurved, the medians separated by a radius, half as far from the smaller laterals. Second row of eyes three-fourths as wide as the posterior row, which are separated by scarcely three diameters and are smaller than the eyes of the second row in the ratio 11:15. Dorsal quadrangle broader than long (103/75), narrowed in front in the same ratio. Posterior eye row narrower than the width of the carapace at that point (10/13). Clypeus equal in height to the diameter of an anterior lateral eye. Sternum longer than broad (15/12). Lower margin of the furrow of the chelicera with three subequal teeth. Epigynum, figure 34.

Legs, 4123, the first tibia with two pairs and a single spine beneath. Last tibia with a basal and submedian dorsal spine.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	1.60	0.67	1.32	1.25	0.50	5.34 mm.
II	1.40	0.64	1.15	1.15	0.50	4.84 mm.
III	1.25	0.55	1.00	1.30	0.50	4.60 mm.
IV	2.00	0.75	1.75	2.25	0.75	7.50 mm.

MALE.—Total length, 3.25 mm. Coloration and structure essentially as in the female. Palpus, figure 36.

TYPE LOCALITY.—Male holotype, female allotype and paratype from Alachua County, Florida, March 23, 1934 (H. K. Wallace). Paratypes from Levy Lake, Florida, March 14, 1934 (H. K. Wallace). Types in the collection of The American Museum of Natural History.

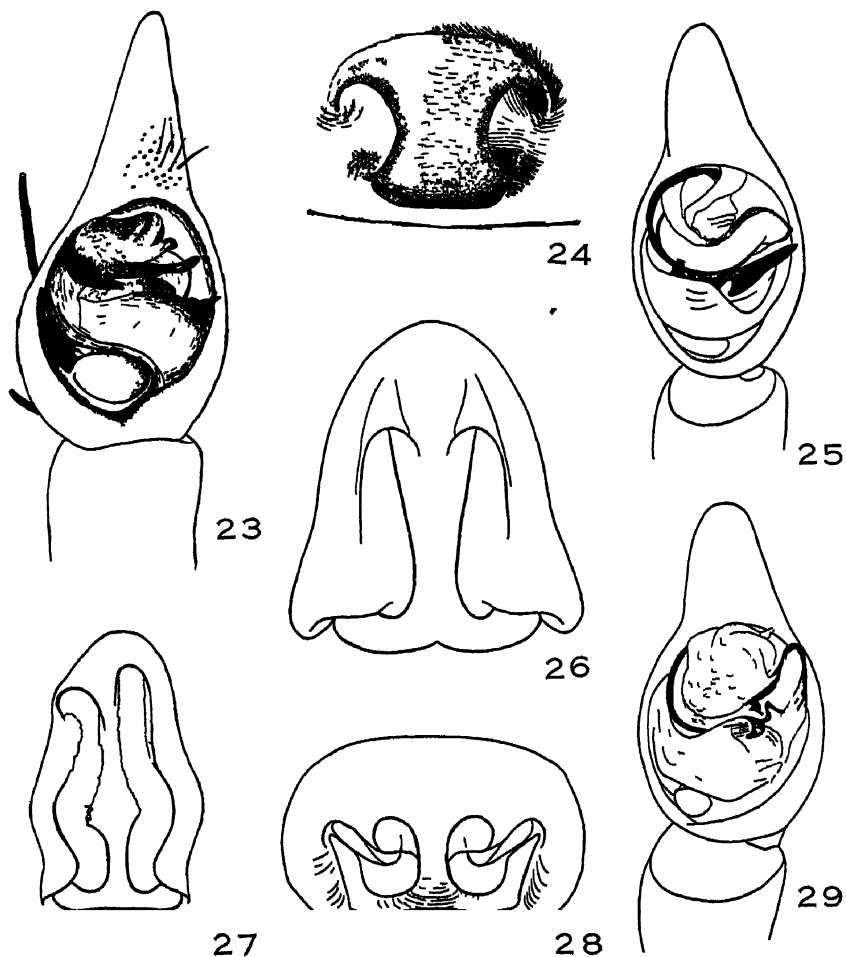
The species is related to *Pirata arenicola* Emerton but differs from it in the details of the palpus and epigynum as figured.

Schizocosa* Chamberlin**Schizocosa unica*, new species**

Figures 21 and 22

MALE.—Total length, 4.00 mm. Carapace, 2.10 mm. long, 1.40 mm. wide.

Carapace dark brown to black, darkest on the sides and in the eye region, the sides clothed with inconspicuous black hairs, the midline paler and clothed with a conspicuous longitudinal band of long white hairs which runs the length of the carapace and is nearly as wide as the interval between the posterior eyes. Sternum, mouth parts and coxae shiny, dark brown, sparsely clothed with fine, erect black hairs. Legs concolorous with the carapace except the tarsi which are yellowish



23. *Arcosa sanctae-rosae*, new species, palp.
24. *Arcosa sanctae-rosae*, new species, epigynum.
25. *Lycosa antelucana* Montgomery, palp.
26. *Lycosa antelucana* Montgomery, epigynum.
27. *Lycosa ceratiola*, new species, epigynum.
28. *Lycosa parthenus* Chamberlin, epigynum.
29. *Lycosa parthenus* Chamberlin, palp.

brown. All the leg joints clothed with black hairs and long spines. Dorsum of abdomen and the sides dark brown, variegated somewhat with white markings, clothed with white pubescence, the hairs of which are longer and more conspicuous on the midline. Venter yellowish brown.

Carapace much longer than broad, the head portion more than half (7/10) as wide as the greatest width. First row of eyes moderately procurved, the medians separated by two-thirds their diameter, a radius from the slightly larger lateral eyes. Eyes of the second row broader than the first (11/8), narrower than the posterior row of eyes (11/13), separated by two-thirds their diameter, fully a diameter from the posterior eyes, which are separated by two and one-half times their diameter. Dorsal quadrangle broader than long (13/11), slightly narrowed in front, the anterior eyes larger (10/7). Clypeus about as high as the diameter of an anterior median eye. Chelicerae with two subequal teeth on the lower margin, three unequal ones on the upper. Sternum longer than broad (20/17). Labium broader than long (6/5), half as high as the endites. Male palpus, figure 22.

Legs, 4123, the tibiae armed with three pairs of ventral spines, the last pair apical, the first two tibiae unarmed above, the last two with a basal and a submedian spine.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	1.40	0 70	1 07	1 15	0.85	5.17 mm.
II	1 25	0 62	0.95	1 07	0 80	4.69 mm.
III	1 17	0.57	0.80	1 12	0 72	4 38 mm.
IV	1 70	0 75	1 37	1 95	1.05	6.82 mm.

FEMALE.—Total length, 5.90 mm. Carapace, 2.50 mm long, 1.65 mm. wide.

Color and structure essentially as in the male. Sternum longer than broad (9/7). Labium slightly broader than long. Chelicerae with two subequal teeth on the lower margin. Epigynum, figure 21.

TYPE LOCALITY.—Male holotype and female allotype from Hope, New Mexico, July 5, 1934 (S. Mulaik). Female paratype from Jeff Davis County, Texas, July, in the collection of Mr. Mulaik. Types in the collection of The American Museum of Natural History.

This small species, though belonging clearly with the Lycosinae, has the labium distinctly broader than long as in *Pardosa* and allied genera. The presence of two teeth on the lower margin will separate it from species of all genera but *Tarentula*. From the species of that genus it differs in the lateral position of the scopus. This species will no doubt be the type of a new genus, but further study of exotic genera must be made to give it a proper position among the known genera of the family.

LYCOSA Latreille

Lycosa acompa Chamberlin

Figure 31

Lycosa acompa CHAMBERLIN, 1924, Proc. U. S. National Museum, LXIII, p. 29, Pl. VI, fig. 45.

MALE.—Total length, 6.10 mm.

Carapace grayish brown on the sides, with a wide median dorsal stripe, yellow in color and with indistinct margins, which ends between the eyes of the second and

third rows. Eye area black. Sides with an indistinct submarginal light band. Carapace sparsely pubescent, with a smooth and shining surface. Sides of the abdomen with deep red and black pubescence, the dorsum lighter in front. Legs yellow, not annulated. Coxae and endites yellow, the labium darker. Sternum with a slight reddish cast. Chelicerae reddish brown, with black pubescence. Venter almost black, with a reddish cast and no definite markings, dark in front of the epigastric furrow.

Carapace longer than broad (3.40 mm./2.70 mm.), rather low (1.80 mm.). Width of the face 1.60 mm. Dorsal eye quadrangle wider than long (10/8), the anterior eyes larger than the posteriors. Anterior row of eyes somewhat narrower than the second row (7/8), slightly procurved, the medians about twice as large as the laterals, the anterior medians and laterals about equally spaced. Clypeus not quite as high as the diameter of an anterior median eye. Chelicerae, 1.30 mm. long, exclusive of the claw, 1.50 mm. wide. Lower margin of the furrow of the chelicera armed with three small teeth, equal in size and equidistantly spaced, the upper margin with three unequal teeth, unequally spaced, the median the largest. Labium as long as broad. Sternum longer than broad (17/14). Palpus, figure 31.

Legs, 4123, all tibiae armed beneath with three pairs of spines, those of legs III and IV relatively longer, the distal pair apical. Tibiae III and IV armed above with proximal and submedian spines. Femora armed above.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	2.50	1.30	2.10	2.00	1.40	9.30 mm.
II	2.30	1.20	1.80	1.80	1.40	8.50 mm.
III	2.20	1.10	1.50	2.00	1.30	8.10 mm.
IV	2.29	1.30	2.30	3.10	1.70	11.30 mm.

RECORDS.—Escambia County, Florida, April 6, 1934, male and female (H. K. Wallace). Edinburg, Texas, male, females (S. Mulaik).

Lycosa parthenus Chamberlin

Figures 28 and 29

Lycosa parthenus CHAMBERLIN, 1925, Bull. Museum of Comparative Zoölogy, LXVII, p. 228.

MALE.—Total length, 7.20 mm., not including the spinnerets.

Carapace yellowish brown, the sides with black pubescence, the median dorsal stripe wide, yellow, widest about the length of the posterior quadrangle behind the third eye row, gradually narrowing from that point to the posterior margin of the carapace, narrowing more abruptly anteriorly, ending between the eyes of the second and third row. Pale stripe enclosing at its widest point two short, parallel, longitudinal dark marks. Submarginal yellow bands distinct, the margins of the carapace black. Eyes incompletely surrounded by black. Dorsum of abdomen reddish brown, with a black maculation of no definite pattern, lighter in front, the anterolateral margins black. Venter light yellow, with a few dark spots, lighter in front of the epigastric furrow. Sternum, labium and endites almost white, cream-colored. Chelicerae light, amber-colored. Coxae and legs yellow, indistinctly ringed in black.

Carapace longer than broad (4.00 mm./2.90 mm.), rather low (1.90 mm.). Width of the face, 1.60 mm. Posterior quadrangle wider than long, in the ratio 10:8, the anterior eyes larger than the eyes of the last row. Anterior row of eyes somewhat

narrower than the second row (7/8), slightly procurved, the medians about twice as large as the laterals, equally spaced. Clypeus not quite as high as the diameter of an anterior median eye. Chelicerae 1.40 mm. long, exclusive of the claw, tapering evenly from their bases distally. Lower margin of the furrow of the chelicerae armed with three medium-sized teeth, equal in size and equally spaced, the upper margin with three unequal teeth, unequally spaced, the median the largest. Labium as long as broad, the basal excavations short. Sternum longer than broad (18/14). Palpus, figure 29. Anterior spinnerets about twice as long and stouter than the posteriors.

Legs, 4123, the second and third subequal. All tibiae armed beneath with three pairs of spines, the distal pairs apical, the spines of legs III and IV relatively longer, the proximal pairs of legs I and two overlapping the middle pairs, the proximal and middle pairs of legs III and IV overlapping the middle and distal pairs respectively. Tibiae III and IV armed above with proximal and submedian spines.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	2 70	1.50	2.20	2.20	1.50	10.10 mm.
II	2 50	1.40	2 00	2 10	1.40	9 40 mm.
III	2.40	1.30	1.80	2.40	1.40	9.30 mm.
IV	3 20	1.40	2.60	3.80	1.80	12.80 mm.

FEMALE.—Epigynum, figure 28.

RECORDS.—Numerous specimens from Alachua County, Lake County, Escambia County, and Levy County, Florida (H. K. Wallace).

Lycosa antelucana Montgomery

Figures 25 and 26

Lycosa antelucana MONTGOMERY, 1904, Proc. Acad. Nat. Sci. Philadelphia, XVIII, p. 282, Figs. 5 and 6.

Lycosa apicata BANKS, 1904, Journal New York Entomological Society, XII, p. 114, Pl. v, fig. 13.

DISTRIBUTION.—Southern United States from Florida (Santa Rosa Island, Pensacola) to Texas, north to Kentucky (Bowling Green), and known in the west from Arizona, Utah, and California.

Since the figures given by Montgomery of the palpus and epigynum of this species are not satisfactory, additional illustrations are presented in this paper.

Lycosa ceratiola, new species

Figure 27

FEMALE.—Total length, 15.20 mm., not including the spinnerets.

Carapace with a wide, yellow, longitudinal area covered with white pubescence. Sides dark, the ground color reddish yellow, clothed with black pubescence. Median dorsal stripe narrow, reddish yellow, widening abruptly about the diameter of a posterior lateral eye in front of the dorsal groove, but covered with black pubescence in such a way as to obscure this widening. As a result, the median dorsal stripe appears to end about midway between where it widens and the posterior lateral eyes.

Eye area covered with white pubescence which extends between the posterior median eyes to the anterior row in a narrow band. Eyes incompletely surrounded by black. Dorsum of the abdomen grayish white, almost without markings of any kind, covered with sparse black pubescence and short black bristles. A hastate mark and four black spots are faintly indicated. Legs light yellow beneath, darker above, the metatarsi and tarsi of legs I and II reddish brown, the femora above with faint indications of black rings. Patellae dark proximally and on the sides. Venter, coxae, sternum, labium, chelicerae and endites black. Abdomen dark in front of the epigynum. Anterior spinnerets twice as long and stouter than the posteriors.

Carapace longer than broad (7.50 mm./5.70 mm.), 4.60 mm. high. Width of the face 3.70 mm. Posterior eye quadrangle wider than long (24/20), the anterior eyes larger than the posteriors (9/8). Anterior row of eyes distinctly shorter than the second row (16/21), almost straight (a line passing through the centers of the anterior median eyes goes slightly above the centers of the laterals), the medians about twice as large as the laterals, the eyes of the row about equally spaced. Clypeus about three-fourths as high as the diameter of an anterior median eye. Chelicerae 3.50 mm. long, exclusive of the claw, 3.30 mm. wide. Lower margin of the furrow of the chelicerae armed with three median-sized teeth, equal in size and equally spaced, the upper margin with three unequal teeth, unequally spaced, the median one distinctly larger than any of the other teeth on either furrow. Labium as long as broad. Sternum longer than broad (20/27).

Legs, 4123, all the tibiae armed beneath with three pairs of spines, the last pair apical, the proximal and middle pairs of legs I and II very much reduced, not as large as the apical pairs. Tibiae III and IV armed above with a proximal and middle spine.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	6.40	3.20	5.10	4.70	2.90	22.30 mm.
II	6.10	3.10	4.90	4.80	3.00	21.90 mm.
III	5.60	2.60	4.30	5.20	3.40	21.10 mm.
IV	6.80	3.00	5.90	7.60	4.20	27.50 mm.

TYPE LOCALITY.—Female holotype and immature paratypes from Lake County, Florida, January 4, 1935 (H. K. Wallace), the holotype in the collection of The American Museum of Natural History, some of the immature paratypes in the collection of Mr. H. K. Wallace.

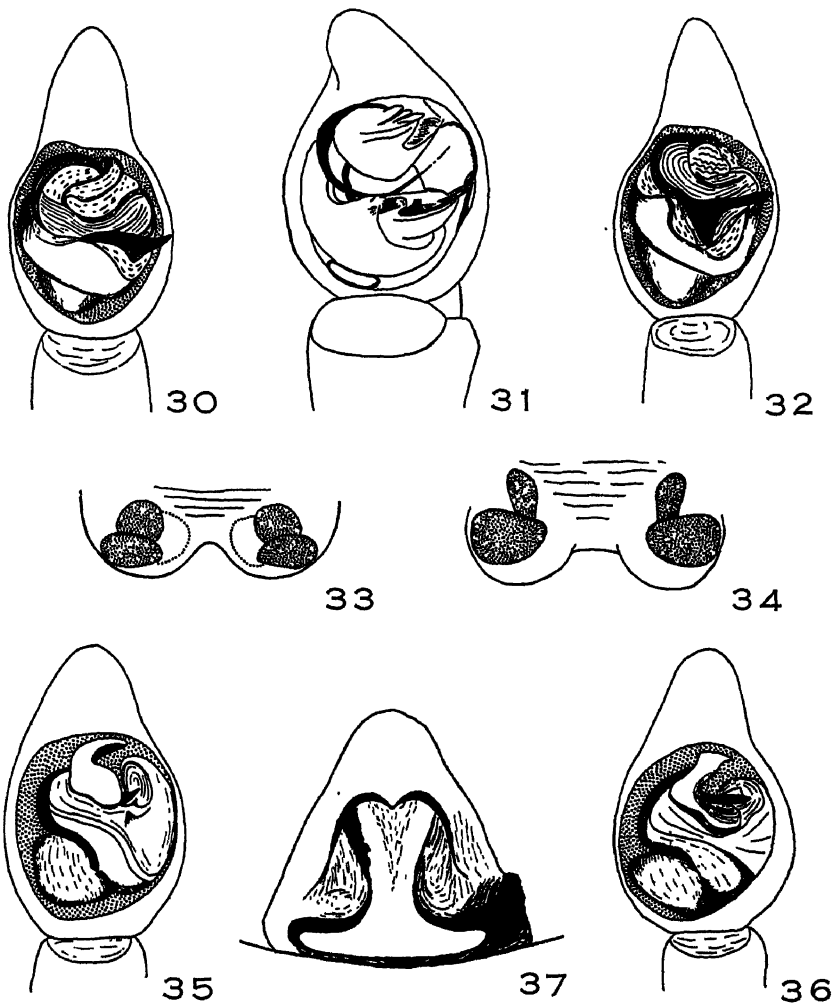
This species looks very much like *Lycosa lenta* Hentz, and they occur together, but *ceratiola* is distinct in the epigynum and in the much reduced spines beneath the first and second tibiae. Only one mature female has been collected to date, but numerous specimens of immature males and females have been taken in the dry sandy area, locally known as the "Ocala Scrub," about seventeen miles east of Umatilla, Florida.

Lycosa tigana, new species

Figure 32

MALE.—Total length, 10.66 mm. Carapace, 4.66 mm. long, 3.80 mm. wide.

Carapace with a median longitudinal yellowish-brown band which begins between the four dorsal eyes, enlarges immediately behind to nearly the width of the last row of eyes, is constricted abruptly at the midline, enlarges again to the end of the



- 30. *Lycosa retenta*, new species, palpus.
- 31. *Lycosa acoma* Chamberlin, palpus.
- 32. *Lycosa tigana*, new species, palpus.
- 33. *Pirata seminola*, new species, epigynum.
- 34. *Pirata alachua*, new species, epigynum.
- 35. *Pirata seminola*, new species, palpus.
- 36. *Pirata alachua*, new species, palpus.
- 37. *Lycosa carrana* Bryant, epigynum.

median suture, at which point it narrows to a third the greatest width, and then goes to the caudal margin. Sides with an irregular submarginal light-brown band that includes the sides of the head and the clypeus and a darker narrow marginal seam. Eyes surrounded by black. The intervals between the pale bands form two irregular brown stripes, which are clothed with fine black hairs. Sternum and coxae pale yellow, the pubescence light in color. Chelicerae dark brown, clothed with white hairs. Labium dark brown, the endites somewhat lighter. Legs light brown, without bands but with irregular dark markings on the basal joints. Dorsum of abdomen gray, with a dark basal hastate maculation and a few irregular dark markings in the caudal half. Venter gray, with a characteristic black, rather small, triangular marking which begins and is broadest at the genital furrow and then is gradually narrowed to a blunt point well in front of the spinnerets, the maculation occupying only the middle portion of the venter, not completely filling at as in *baltimoriana* or *coloradensis*.

First row of eyes nine-tenths as broad as the second, procurved, the medians separated by a radius, half as far from the laterals, which are about two-thirds as large. Eyes of the second row five-sixths as broad as the posterior row, separated by more than half their diameter (7/11), a little farther from the eyes of the third row (8/11). Posterior eyes separated by two diameters, smaller than the eyes of the second row (8/11). Quadrangle of dorsal eyes broader than long (31/23), narrowed in front. Clypeus as high as the diameter of an anterior lateral eye. Lower margin of the furrow of the chelicera with three teeth, the one nearest the claw smaller, the upper margin with three teeth of which the median is much larger. Sternum longer than broad (16/13). Labium longer than broad (6/5). Palpus, figure 32.

Legs, 4123. All tibiae with three pairs of stout ventral spines, the last pair apical. First and second tibiae with a single submedian dorsal spine, the third and fourth tibiae with an additional stout basal spine.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	4.46	2.24	3.80	3.80	2.30	16.60 mm.
II	4.14	2.00	3.44	3.95	2.17	15.70 mm.
III	4.14	1.80	3.18	4.14	2.27	15.53 mm.
IV	4.84	2.27	4.34	5.70	3.04	20.19 mm.

TYPE LOCALITY.—Male holotype and paratype from Edinburg, Texas (S. Mulaik), in the collection of The American Museum of Natural History.

This species is immediately separable from *Lycosa lenta* and *baltimoriana* by the much smaller size and the greatly reduced black maculation on the venter of the abdomen. In these species the sternum and coxae are black; in the latter species the legs are annulate. The palpus places *Lycosa tigana* near these species but differs in details as shown in the figure. *Lycosa antelucana* Montgomery, closely allied to the species mentioned, has the last leg annulate as in *baltimoriana* and often has the venter of the abdomen and the sternum and coxae completely suffused with black. The median apophysis of that species, however, is of quite a

different form. The palpus of *Lycosa tigana* is very close to that of *Lycosa fusca* Keyserling, a West Indian form, but the median apophysis is distinctly larger and has a more conspicuous caudal lobe.

***Lycosa retenta*, new species**

Figure 30

MALE.—Total length, 12.50 mm. Carapace, 6.00 mm. long, 4.60 mm. wide.

Carapace with a median longitudinal light-brown band as wide as the interval between the posterior eyes, slightly narrowed at the caudal margin, in front extending between the dorsal eyes. Sides brown, without a distinct submarginal light band. Eyes ringed in black, partially covered with white hairs. Carapace evenly covered with fine hairs that agree in color with the chromatism. Sternum, mouth parts, and coxae light brown, sparsely clothed with fine hairs. Legs light brown in color, without markings, rather thickly clothed with white pubescence and black hairs. Dorsum of the abdomen yellowish brown, with a basal dark-brown hastate maculation and dark side markings forming indistinct longitudinal stripes. Venter with a dark-brown maculation just behind the genital furrow, otherwise pale brown. Spinnerets brown.

First row of eyes five-eighths as broad as the second, slightly procurved, the medians separated by a radius, scarcely as far from the laterals, which are two-thirds as large. Second row of eyes eight-ninths as broad as the posterior rows, two-thirds their diameter apart, one diameter from the posterior eyes. Posterior eyes scarcely two diameters apart, smaller than the eyes of the second row (8/9). Dorsal eye quadrangle scarcely broader than long (25/24), slightly narrowed in front. Clypeus equal in height to the diameter of an anterior lateral eye. Lower margin of the furrow of the chelicera with three subequal teeth, the upper margin with three unequal teeth, the median one the largest. Sternum longer than broad (21/17). Labium longer than broad (10/9). Palpus, figure 30.

Legs, 4123, all tibiae with three pairs of stout ventral spines, the last pair apical, and with a single basal and submedian dorsal spines.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	5.32	2.32	4.66	5.32	2.40	20.02 mm.
II	5.00	2.32	4.40	5.12	2.35	19.19 mm.
III	4.66	2.20	4.00	5.32	2.35	18.53 mm.
IV	6.00	2.50	5.04	7.12	2.84	23.50 mm.

TYPE LOCALITY.—Male holotype and immature female allotype from Austin, Texas (J. H. Montgomery), in the collection of The American Museum of Natural History.

This species is not closely allied to *Lycosa coloradensis* Banks, with which it agrees somewhat in color markings. Banks' species is much more robust, has the quadrangle of the dorsal eyes proportionately much broader than long, and has no dorsal spines on the first two tibiae. In addition, *Lycosa coloradensis*, which is a burrower, has distinct dark annulae on the legs. The palpus would seem to place *Lycosa retenta*

near the group of species of which *Lycosa antelucana* and *Lycosa lenta* are representatives, but from these species it differs in the much narrower pars cephalica and in the distinctive color markings, which in this group are of prime importance in placing the species.

***Lycosa carrana* Bryant**

Figure 37

Lycosa carrana BRYANT, 1934, Psyche, XLI, pp. 38-39, Fig. 1.

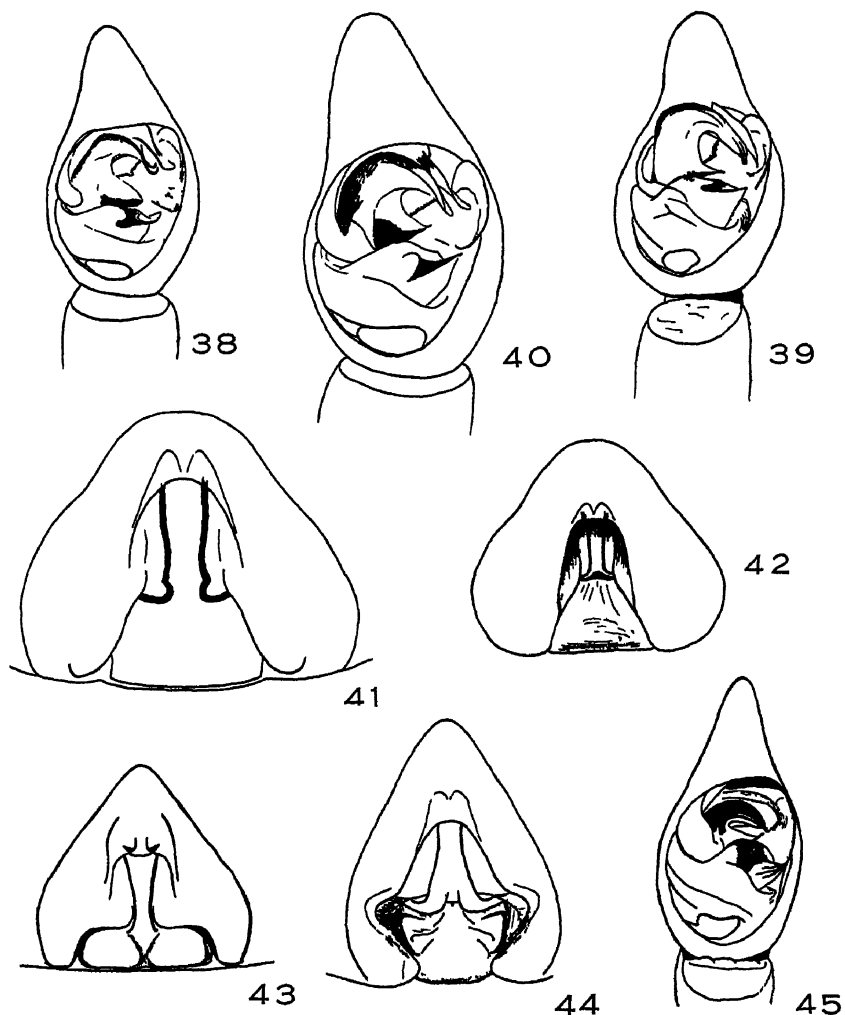
FEMALE.—Total length, 16.50 mm., not including the spinnerets.

Carapace and legs mainly yellow, the abdomen darker, grayish. Median light band of the cephalothorax narrowing in front of the dorsal groove and again behind the eyes, continued forward as a narrow band of white hairs between the posterior eyes and partly between the eyes of the second row. Parallel dark bands on each side of the median band slightly wider than the median band, extending from the posterior margin of the carapace to the clypeus, barely enclosing the eyes on each side. Sides with a narrow marginal dark band. All eyes more or less surrounded by a black area. Face marked with two dark stripes extending from the posterior median eyes to the chelicerae and enclosing the anterior laterals. Abdomen with a wide median dark band, almost black behind but extending forward from about the middle as two dark lines enclosing a brown area. A narrow light band on each side of the median dark band. Sides of the abdomen dark gray. From the dorsal aspect this species looks almost exactly like *Lycosa punctulata* Hentz, which is common in Florida, differing only in the shape of the median light band of the carapace, the occurrence of the brown area in the anterior half of the median dark band of the abdomen and the relative widths of the light bands on each side of the median dark band of the abdomen. Venter black, usually bearing ten spots of white hairs arranged in four rows of two each from front to back, with an additional one lateral to the third row on each side. Occasional examples have only six spots. Sternum black, the coxae of the legs dark beneath. Chelicerae, endites, the dorsum of the coxae, and trochanters reddish brown. Patellae, tibiae, and tarsi of the palpi, also metatarsi and tarsi of the legs, reddish brown. All femora gray beneath. Labium darker than the endites.

Carapace longer than broad (7.60 mm./5.60 mm.), 4.70 mm. high. Posterior eye quadrangle wider than long (24/18), the anterior eyes larger than the posteriors (8/7). Anterior row of eyes narrower than the second row (15/20), distinctly procurved, the eyes equal and equidistant. Clypeus less than half as high as the diameter of an anterior lateral eye. Chelicerae 3.10 mm. long, exclusive of the claw, 3.00 mm. wide. Lower margin of the furrow of the chelicera armed with three equal, medium-sized teeth, the upper margin with three unequal teeth, the median the largest. Labium as long as wide. Sternum longer than wide (30/25). Epigynum, figure 37. Spinnerets equal in length, the anterior pair somewhat stouter. Abdomen longer than wide (95/61).

Legs, 4123, all the tibiae armed beneath with three pairs of spines, the distal pair apical. Tibiae III and IV with proximal and submedian spines above. Tibia and patella I, 7.30 mm. long, IV, 7.90 mm. long.

RECORDS.—Five adult females (one of which is designated as the allotype) and one immature male from Levy County, Florida, April 28,



38. *Lycosa pulchra* (Keyserling), palpus.
39. *Lycosa kochi* Emerton, palpus.
40. *Lycosa huberti* Chamberlin, palpus.
41. *Lycosa pulchra* (Keyserling), epigynum.
42. *Lycosa kochi* Emerton, epigynum.
43. *Lycosa huberti* Chamberlin, epigynum.
44. *Lycosa euepigynata* Montgomery, epigynum.
45. *Lycosa euepigynata* Montgomery, palpus.

1934, on an island about five miles from the town of Cedar Keys, captured at night with a headlight in reeds above the high tide mark. Many adult males and females collected in Monroe and Dade Counties, Florida, February 7, 1935 (J. Kilby, R. E. Bellamy and F. Blair). Several were also taken in the Everglades. They report this species as one of the commonest forms in the southern end of Florida. The allotype and other specimens are in the collection of The American Museum of Natural History.

The following four species are closely related and two of them, *Lycosa pulchra* Keyserling and *Lycosa kochi* Emerton, have been frequently confused. This has been due primarily to the nature of the original descriptions which are, for the most part, inadequate. Montgomery in 1902 discussed the situation and proposed to discard the name *gulosus* Walckenaer, the first name applied to one of these four species. Gertsch in 1934 (American Museum Novitates, No. 726, pp. 7-8) distinguished between the species but retained the name *gulosus*. In his revision of 1908, Chamberlin included three of these species under Walckenaer's name. It seems advisable at this time to review the situation again.

As a preface it may be stated that a study of the descriptions has convinced us that no description is in existence in which *kochi* and *pulchra* can be separated without the aid of figures of the male palpi or the female epigyna when these two species are considered throughout the range of their variations. The palpi and epigyna have been found to be constant in each species in all the specimens studied.

Walckenaer, in 1837, gave a very brief description, without figures, of *Lycosa gulosus* from North America. If he had given a definite locality, or if he had figured his species, it would not be difficult to place the name, providing, of course, that it was one of the two forms under consideration, which is far from certain. In the light of the confusion that has existed since then, it seems advisable to accept Montgomery's proposal to discard this name. In 1876 Keyserling described *Lycosa pulchra* in great detail. However, without his figure of the epigynum it would be a difficult task to distinguish between the two species in question. One is confined to the southeastern part of the United States and has been collected as far west as Texas and as far north as North Carolina. The other is more northern in its distribution, being common in the northern United States east of the Rocky Mountains and occurring along with the other species as far south as North Carolina. The species described by Keyserling, the type locality of which is simply the "United States," is

presumed to be the southern one and the figure of the epigynum seems to support this contention adequately. Emerton incorrectly identified and figured this northern species as *Lycosa kochi* (Keyserling). The figure of the male palp in his paper leaves no question as to the identity of the thing he was describing and, because Emerton placed it in another genus, the name becomes available and is used for the northern form in this paper. *Lycosa euepignata* Montgomery was synonymized with *gulosa* by Chamberlin in 1908, but it is quite distinct. The fourth species, *Lycosa huberti* Chamberlin, was described from the female, so a description and figure of the male palpus are included. These last two forms are perfectly distinct in the epigynum and the palpi and can scarcely be confused with the others. Figures of the palpi and epigyna of all four species are included for comparison.

***Lycosa kochi* Emerton**

Figures 39 and 42

Lycosa kochii EMERTON, 1885, Trans. Connecticut Acad. Arts and Sciences, VI, p. 485, Pl. XLVI, fig. 6. (Not *Tarentula kochi* Keyserling.)

Lycosa nigraurata MONTGOMERY, 1902, Proc. Acad. Nat. Sci. Philadelphia, p. 564, Pl. xxx, fig. 53.

Lycosa purcelli MONTGOMERY, 1902, idem, p. 566, Pl. xxx, figs. 30 and 31.

DISTRIBUTION.—United States and Canada east of the Rocky Mountains, south to North Carolina.

RECORDS.—Larchmont, N. Y., Sept. 11, 1932 (Gertsch). Baldwin, Long Island, N. Y., April 21, 1908. Ramsey, N. J., Sept. 16, 1934 (Gertsch). Near Englewood, N. J., April 30, 1933 (Gertsch). Norwalk, Connecticut, May and June, 1933 (Gertsch). Ann Arbor, Michigan (E. L. Miner). St. Croix Falls, Wisconsin, Nov., 1931 (Gertsch). St. Paul, Minnesota, June 4, 1932 (R. W. Macy). Minneapolis, Minnesota, June 1, 1932 (Gertsch). Wacouta Beach, Lake Pepin, Minnesota, May 15, 1932 (Gertsch). Darke County, Ohio (T. H. Hubbell). Montvale Springs, Tennessee, March 18, 1929 (W. M. Barrows). Sides of Mount Leconte, Sept. 8, 1928 (W. M. Barrows). Burlington, North Carolina (H. K. Wallace). Lake James, North Carolina (H. K. Wallace).

***Lycosa pulchra* (Keyserling)**

Figures 38 and 41

Tarentula pulchra KEYSERLING, 1876, Verh. K. K. Zool.-Bot. Gesell., Wien, XXVI, p. 628, Pl. I, figs. 13 and 14.

Lycosa insopita MONTGOMERY, 1904, Proc. Acad. Nat. Sci. Philadelphia, p. 280, Pl. xviii, figs. 3 and 4.

RECORDS.—Austin, Texas (Montgomery). Florida (numerous examples from the central part). Burlington, North Carolina.

***Lycosa euepigynata* Montgomery**

Figures 44 and 45

Lycosa euepigynata MONTGOMERY, 1904, Proc. Acad. Nat. Sci. Philadelphia, p. 279, Pl. XVII, figs. 1 and 2.

DISTRIBUTION.—This species has been reported only from Texas.

***Lycosa huberti* Chamberlin**

Figures 40 and 43

Lycosa huberti CHAMBERLIN, 1924, Proc. U. S. National Museum, LXIII, pp. 28-29, Pl. VI, fig. 44.

MALE.—Total length, 9.50 mm., not including the spinnerets.

Integument of the carapace dusky, or chocolate brown, with a wide median light stripe that is constricted behind the posterior lateral eyes and again in front of the dorsal groove, narrowing behind the dorsal groove, the sides with a marginal light band. Head region darker than the remainder of the cephalothorax, the region around the eyes black. Dorsum of the abdomen light in front, with a brown hastate mark outlined in black, dusky gray behind and with indistinct chevrons. Sides dark or dusky gray, the anterolateral margins darker, almost black. Chelicerae deep reddish-brown. Venter dusky, without definite markings. Sternum and endites reddish brown, the labium darker. Coxae, trochanters, and femora of all legs with a yellowish cast, the patellae, tibiae, and metatarsi reddish brown, none of the joints annulate.

Carapace longer than broad (5.20 mm./4.00 mm.), 3.00 mm. high. Width of the face, 2.40 mm. Dorsal eye quadrangle wider than long (16/12), the anterior eyes larger than the posteriors (5/4). Anterior row of eyes narrower than the second (10/12), slightly procurved, the eyes about equidistant, the medians larger. Clypeus about as high as the diameter of an anterior median eye. Chelicerae as wide as long (2.00 mm./2.00 mm.). Lower margin of the furrow of the chelicera armed with three medium-sized teeth, equal in size and equally spaced. Specimens have been observed with only two teeth and one with a very small additional fourth tooth. Upper margin with three unequal teeth, unequally spaced, the median the largest. Labium as long as wide. Sternum longer than wide (24/19). Palpus, figure 40.

Legs, 4123, all tibiae armed beneath with three pairs of spines, the distal pair apical in position, armed above with a basal and middle spine on tibiae III and IV only. Tibia and patella I, 5.70 mm. long, IV, 5.70 mm. long.

FEMALE.—Total length, 12.00 mm., not including the spinnerets.

Color and markings similar to the male. Carapace longer than broad (5.10 mm./4.00 mm.), 3.00 mm. high. Width of the face, 2.60 mm. Posterior eye quadrangle wider than long (16/12), the anterior eyes larger than the posteriors (5/4). Anterior row of eyes narrower than the second row (10/12), procurved, the medians larger and slightly nearer the laterals than each other. Clypeus about as high as the diameter of an anterior median eye. Epigynum, figure 43.

Legs, 4123, spined as in the male. Tibia and patella I, 5.10 mm., IV, 5.50 mm. long.

RECORDS.—Alachua County, Florida, Jan. 16, 1933, male and female (H. K. Wallace). The male is designated as the allotype. Alachua County, Florida, April 17, 1934, female (H. K. Wallace).

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THE TIFFANY FAUNA, UPPER PALEOCENE

I.—MULTITUBERCOLATA, MARSUPIALIA, INSECTIVORA, AND ?CHIROPTERA

BY GEORGE GAYLORD SIMPSON

INTRODUCTION

The Tiffany fauna has become the characteristic or almost classical fauna of the American Upper Paleocene and the name Tiffany has come into wide use for the zone and time represented by the fauna, but it has been described incompletely and in scattered papers or in incidental notes included in work on other subjects. Some of the fossil mammals of the Tiffany have never been named, most of them have never been figured, and only two have been adequately described.

Practically all of the known specimens were collected by Dr. Walter Granger (with Mr. George Olsen) in 1916 and are in the American Museum. As referred to in more detail below, Matthew and Granger have published several notes on the Tiffany and its mammals, but these were for the most part brief and preliminary, and no general review has appeared. It was expected that Doctor Matthew would take up the definitive study in conjunction with his revision of the Puerco and Torrejon, but at the time of his death in 1930 he had not yet undertaken the Tiffany study and except for brief mention and the description of one new species it is omitted from the manuscript which he left.

As I am engaged in a revision of the Montana Fort Union fauna and have in this connection and in others had occasion to familiarize myself with the Tiffany fauna, Doctor Granger has now placed it in my hands and requested that I complete the description which he and Doctor Matthew so ably began. One manuscript diagnosis, that of *Periptychus superstes* Matthew, was available and has been directly quoted below.

The present paper contains the introductory material, résumés, and the orders Multituberculata, Marsupialia, Insectivora, and ?Chiroptera. A second paper will be devoted to *Plesiadapis* and a third to the remainder of the fauna. References are given at the end of the third paper. The drawings in all three papers are by Mrs. Mildred Clemans.

PREVIOUS WORK

The formation (or faunal zone) later designated as Tiffany was discovered by J. W. Gidley in 1909. He then visited southwestern Colorado with J. H. Gardner, of the U. S. Geological Survey, and found a few fragmentary mammals later tentatively identified as follows.¹

Coryphodon.²

Phenacodont intermediate between *Phenacodus* and "*Euprotogonia*" [= *Tetraclaenodon*].

Hemiacodon? (sp. nov.).

"*Nothodectes*" sp. [= *Plesiadaps*].

He concluded that the fauna is intermediate between the Fort Union or Torrejon and the Wasatch.

On information received from Gidley, Granger examined these beds in 1916. He then made the collection which is the subject of the present revision and published an account of the stratigraphy, with notes on the fauna (Granger 1917). He applied the name Tiffany Beds to the horizon of these fossils and tentatively correlated it with the Clark Fork. While the preparation of the extremely delicate material by Miss Erna Kohlhaase was in progress, Matthew (1917a, 1917b) published preliminary descriptions of *Zanycteris paleocena* and "*Nothodectes*" *gidleyi*. A few years later, Matthew and Granger (1921) published brief, unillustrated diagnoses of the following Tiffany genera and species: *Ectypodus musculus*, *Peradectes elegans*, *Leptacodon tener*, *Xenacodon mutilatus*, *Labidolemur soricoides*, *Ignacius frugivorus*, *Nava-jovius kohlhaasae*, and *Carpodaptus aulacodon*. *Ectypodus musculus* was figured and more fully described by Granger and Simpson (1929). In connection with work on other Paleocene faunas, a number of students have examined this incompletely published Tiffany collection, and papers by Jepsen, Russell, Simpson, and others contain references to it, or involve unpublished observations on it, but no studies other than those cited above are directly descriptive of it. Although a few fragments, not adding to knowledge of the fauna, have been picked up in passing, there has not been, to the best of my knowledge, any intensive collecting in the Tiffany since 1916, and the collection of that season remains practically the whole basis for knowledge.

¹Gidley, 1917 (a brief note inserted in a paper by C. H. Wegemann).

²These generic determinations are probably erroneous, or the fossils were from a higher horizon. The specimens were very fragmentary and have been lost or discarded.

OCCURRENCE

The occurrence of the Tiffany fauna has been described by Granger (1917) and the following is abstracted from his more extended account: The area in question is in southwestern Colorado, near the boundary with New Mexico, on the northern drainage slope of the San Juan River, and is included in an arc on which lie the settlements or stations Ignacio, Tiffany, Arboles, and Pagosa Junction. Granger's map shows nine fossil localities, the most distant about ten miles apart, on the valley slopes facing Spring Creek on the west, the San Juan River on the south, and on the two sides of the Piedra River valley, which runs southward to the San Juan through the middle of this area. The great majority of the specimens, however, are from a limited area in the most western of the fossiliferous exposures, four to five miles north of the station of Tiffany, in Sec. 20, T. 33 N., R. 6 W.

As regards occurrence, the fossils fall into two categories. A few, for the most part the larger animals of the fauna, were found isolated at scattered localities. Many, exclusively small to minute animals, were found in a single small pocket of gray shale imbedded in a stratum of mottled purplish and brownish clay. "This gray shale mass was irregular in shape and less than half a cubic yard in bulk, although probably considerably reduced by erosion, and having all the appearance of being the filling of a fissure formed in the mottled clay. . . . The fossils are rather evenly distributed through the matrix. . . . The occurrence of so many small forms in this deposit and the absence of any of the larger ones suggests that they may be the remains of animals brought into a fissure by a small predatory animal" (Granger 1917, pp. 827-828). The fossils found in this pocket, called the Mason Pocket by Granger from the nearby Mason schoolhouse, and those found elsewhere are listed separately below.

FAUNAL LIST

The Tiffany fossils so far identified are here listed, with the number of specimens of each found in the Mason Pocket and elsewhere.¹

¹The exact number of individuals in the Mason Pocket cannot be determined. The mass contained quantities of isolated bones and teeth, but I have not included them in the numbers given unless they were characteristic and fully identifiable.

Name	Mason Pocket	Elsewhere
MULTITUBERCULATA		
Ptilodontidae		
<i>Ectypodus musculus</i>	12 +	
MARSUPIALIA		
Didelphidae		
<i>Peradectes elegans</i>	20	
INSECTIVORA		
Leptictidae		
<i>Leptacodon tener</i>	2	
<i>Xenacodon mutilatus</i>	1	
?CHIROPTERA		
?Phyllostomatidae		
<i>Zanycteris paleocena</i>	1	
PRIMATES		
Plesiadapidae		
<i>Plesiadapis gidleyi</i>	20 +	1
Apatemyidae		
<i>Labidolemur soricoides</i>	2	
Carpolestidae		
<i>Carpodaptes aulacodon</i>	1	
Anaptomorphidae		
<i>Navajovius kohlhaasae</i>	3	
Family uncertain		
<i>Phenacolemur frugivorus</i>	7	
CARNIVORA		
Arctocyoniidae		
<i>Chriacus</i> sp.		1
<i>Thryplacodon australis</i>	1	
Mesonychidae		
? <i>Dissacus</i> sp.		1
CONDYLARTHA		
Phenacodontidae		
<i>Phenacodus grangeri</i>		9
<i>Phenacodus mathewi</i>		1
<i>Phenacodus gidleyi</i>		1
<i>Phenacodus</i> sp.		1
AMBLYPODA		
Periptychidae		
<i>Periptychus superstes</i>		5
<hr/>		
TOTALS:	70 +	20

FACIES

It is evident that the facies of the Mason Pocket is very peculiar, and the marked difference between this and the rest of the formation demonstrates that strata may be identical in age and yet have remarkably different faunas.¹ The fauna of the formation outside the pocket, while scanty, seems quite usual and is comparable in facies to that of the great majority of Tertiary deposits, predominantly ungulates, with a few carnivores. It is evidently a normal terrestrial fauna and the deposits are those of flood plains.

In the pocket there are no ungulates and only one carnivore, of small size, and the great majority of the fossils represent minute animals of groups elsewhere very rare. Several specimens of *Plesiadapis* have now been found at other American localities, but it is still rare elsewhere. *Peradectes* has not been found at any other locality, and only one other specimen of a didelphid has ever been encountered in the whole American Paleocene. Multituberculates are common in some other deposits, but, especially the small and delicate forms, seldom make up such a large percentage of the fauna (at least 17 per cent). Several of the animals rare here are quite unknown elsewhere.

A full explanation of the peculiarity is impossible, but it seems clear that the majority of the Mason Pocket animals, and perhaps all of them, are arboreal. *Plesiadapis* can be designated as arboreal with little question, its skeleton having very numerous characters usually associated with such a station. With the other genera, judgment must be based more largely on inference, but it is very probable that the small multituberculate, the *Marmosa*-like marsupial, and all the primates were also arboreal. The other groups, leptictids, ?bat, and small carnivore may well have been arboreal also. In Tertiary deposits in general arboreal mammals are rare, and this characterizes the difference of facies, although of course it does not explain just how it happened that arboreal animals were preserved in this case and are so rare elsewhere.

A typical collection of mammals from a coal mine at Bear Creek, Montana, contains the following numbers of identified individuals.

¹Incidentally, it once more exposes the fallacy of "percentage correlation," often criticised but still popular in some quarters. Of fifteen species definitely identified, one, or less than 7 per cent of the combined fauna, is common to the Mason Pocket and the other facies of the formation. If they were not known to be of the same age, this fallacious means of correlation would separate them very widely.

INSECTIVORA

Plagiomenidae	
<i>Planetherium mirabile</i>	29 +
Nyctitheriidae	
<i>Protentomodon ursivalis</i>	5
?Pantolestidae	
? <i>Pentacodon</i> cf. <i>inversus</i>	2
Leptictidae	
<i>Leptacodon siegfriedti</i>	10

PRIMATES

Plesiadapidae	
<i>Apatemyidae</i>	
<i>Labidolemur kayi</i>	1
Carpolestidae	
<i>Carpolestes nigridentis</i>	3
<i>Carpolestes aquilae</i>	3

TAENIODONTA

Stylinodontidae	
? <i>Psittacotherium loddelli</i>	2

CARNIVORA¹

Arctocyoniidae	
<i>Thryptacodon pseudarctos</i>	2

CONDYLARTHERA

Phenacodontidae	
<i>Phenacodus</i> cf. <i>primaevus</i>	1

This fauna is of about the same age as that of the Tiffany and has five genera in common with the latter and another (*Carpolestes*) very nearly allied (to *Carpodactes*), yet it is evidently of very different facies. *Plesiadapis* is abundant in the Mason Pocket, very rare at Bear Creek; *Leptacodon* is common at Bear Creek, rare in the Mason Pocket; and so on. But still more striking is the total absence at Bear Creek of any allies of two of the commonest Mason Pocket fossils, *Ectypodus* and *Peradectes*, while far the most common Bear Creek genus, *Planetherium*, has no ally in the Tiffany fauna. The Bear Creek fauna seems also to include arboreal elements, although less exclusively arboreal in nature, and the difference must be sought in other factors of environment or of mode of deposition of the fossil beds. On the former score, the more northern locality may have some bearing on climate and on both the fact that the Bear Creek fossils are found in immediate proximity to a coal seam is almost surely significant.

¹There are several other creodonts, but their remains are too fragmentary for identification.

AGE

Gardner (in Lee, 1912) included the then unnamed Tiffany Beds and the overlying thick barren series in the "Wasatch," in default of clear fossil evidence. Gidley (in Wegemann, 1917), on the basis of the few fossils then known to him, considered the fauna as intermediate between the Fort Union and the Wasatch, or, to paraphrase his words and make his meaning more clear in present terminology, between the Torrejon and the Gray Bull, a conclusion now considered beyond question. Granger (1917) reached the same conclusion (expressed in slightly different words) and suggested that "the closest correlation . . . seems to be with the Clark Fork beds of Wyoming." Regarding the quite different question as to where the Paleocene-Eocene line should be drawn, Granger was then (1917) inclined to draw it below the Tiffany and Clark Fork, and Matthew above them. This of course involves no difference of opinion as to the position of these horizons in the sequence. This view, with numerous differences as to the Paleocene-Eocene line, remained practically unchallenged, and indeed the Tiffany, in spite of inadequate publication of its fauna, came to be considered and used more or less as the standard Upper Paleocene. Differences between Tiffany and Clark Fork were noted, and comparisons made separately, but it was not known whether these indicated a measurable age difference or were entirely facial. I suggested (Simpson 1929), very tentatively, that the Clark Fork might be slightly later. This was confirmed and the known or suspected sequence of the four known Paleocene faunas placed beyond question by Jepsen's discovery (1930) of a continuous series in which equivalents of all of them occur, as follows.

Clark Fork
Tiffany
Torrejon
Puerco¹

As the Tiffany and Clark Fork are more nearly related to each other than are any other two successive members of this series, they are commonly considered as Upper Paleocene, the Middle and Lower Paleocene including the Torrejon and Puerco, respectively, with their equivalents.

¹This incidentally established (with great probability) the presence of a Puerco equivalent in the northern area. It had been supposed that the Puerco occurred there, but no fossils had been found to prove this, and the non-mammal-bearing beds in which it would necessarily be included if present were, and in most areas still are, distributed between the Fort Union and the Lance on no very clear criteria by various authors.

The sequence and the position of the Tiffany in it are thus established as exactly as may be, until other possible intermediate horizons are discovered. The Tiffany-Clark Fork-Sand Coulee series seems to be almost completely transitional, so that no intercalation is here probable, but another faunal zone may well be discovered between the Puerco and the Torrejon and between the Torrejon and the Tiffany as now known.

Other Tiffany equivalents had already been recognized, before Jepsen's discovery of the full sequence, in the Paskapoo of Alberta (Simpson, Russell) and in the Fort Union at Bear Creek, Montana (Simpson). The fifteen genera now recognized in the Tiffany (*sensu stricto*) are distributed as follows in time.

	TORREJON	TIFFANY (AND EQUIVALENTS)	CLARK FORK	LOWER EOCENE
<i>Ectypodus</i>	?	×		
<i>Peradectes</i>		×		
<i>Leptacodon</i>		×		
<i>Xenacodon</i>		×		
<i>Zanycteris</i>		×		
<i>Plesiadapis</i>		×	×	?
<i>Labidolemur</i>		×		
<i>Carpodaptes</i>		×		
<i>Navajovius</i>		×		
<i>Phenacolemur</i>		×	×	×
<i>Chriacus</i>	×	×		×
<i>Thryptacodon</i>		×	×	×
<i>Dissacus</i>	×	?	×	×
<i>Phenacodus</i>		×	×	×
<i>Peripitychus</i>	×	×		

Many of the small mammals have little bearing on age relationships, as the phyla to which they belong are not known in either earlier or later beds. *Plesiadapis* is more advanced than its Torrejon forerunner, *Pronothodectes*, and somewhat (but less markedly) less advanced than Clark Fork-Lower Eocene species placed, at least tentatively, in the same genus. *Labidolemur* is replaced in the Lower Eocene by *Teilhardella*; no Clark Fork representative of this phylum is yet known. *Carpodaptes* is more advanced than its probable ancestor *Elphidotarsius* of Torrejon age, and slightly more primitive than *Carpolestes* with which it is, nevertheless, nearly or quite contemporaneous. The Tiffany representative of the *Phenacolemur* group may be somewhat more primitive than the Clark Fork and later species, but this is not wholly clear. The

creodonts are rather inconclusive, but the *Thryptacodon* seems to be about as advanced as the later species, and no closely similar form is known in the Torrejon. The condylarths, as far as can be exactly determined, are of primitive Eocene, rather than Middle Paleocene, type. *Peripitychus* is the only distinctly Middle Paleocene element, and as a survival it is less important than are the more progressive lines as an indication of time relationships.

The Tiffany fauna thus is intermediate in character between the Torrejon and the Clark Fork and Lower Eocene faunas, as universally recognized, but its affinities are preponderantly with the known later faunas, and it very possibly stands nearer even to the unquestioned Eocene Sand Coulee¹ and Gray Bull in time than it does to the Torrejon. By this I do not mean to imply that it should be united with the Eocene and excluded from the Paleocene. That is a question which should, I think, be decided on other criteria. The suggestion is only that there is at present a gap in our knowledge of Paleocene faunas between the Torrejon and the Tiffany. Anticipating conclusions, the basis for which cannot be given here, I believe that the boundary in our essentially continuous Paleocene-Eocene stratigraphic series is more conveniently and naturally drawn above the Clark Fork than below the Tiffany, and certainly there is yet little or no good evidence for drawing it between Tiffany and Clark Fork.

Since the Upper Paleocene, as here defined, was recognized, it has been generally agreed that the French Cernaysian, or the Thanetian of which it is a local facies, is approximately equivalent to the Tiffany or Clark Fork or both. The evidence (see, e.g., Teilhard 1921, Simpson 1929c) need not be reviewed in any detail, but the close similarity of a few mammals, *Plesiadapis*, *Thryptacodon*-*Arctocyonides*, and one or two others, and, still more, the similar relationships to the overlying true Lower Eocene, Gray Bull and Sparnacian, are quite convincing. It is also probable that the Asiatic Gashato and possible that the South American Río Chico are approximate equivalents of the Tiffany, but in these cases the evidence is still less direct and the correlation still very uncertain.

¹Abel (1931) calls the Sand Coulee Paleocene, but this is perhaps a *lapsus*, as I know of no American student of its fauna who does not consider it as Eocene. Jepsen even unites it with the Gray Bull

REVISION OF FAUNA
MULTITUBERCULATA

PTILODONTIDAE

***Ectypodus musculus* Matthew and Granger, 1921**

This genus and species have been described in detail by Granger and Simpson (1929, pp. 652-656), and it seems unnecessary to repeat the description. The only dubious point is the presence or absence of P_3 . Matthew and Granger stated that this tooth was absent. Granger and Simpson, influenced by the presence of a large basal notch on P_4 and obscure signs of what might be an alveolus stated that it may have been present. There are four specimens in which the region of P_3 is shown. In one, least well preserved here, there might be an alveolus, and in the other three there apparently is none. In spite of the notch in P_4 apparently for the reception of P_3 , the presence of the latter tooth is highly dubious. The propriety of maintaining *Parectypodus* Jepsen as distinct is thus in question, depending certainly only on the reduction of the notch of P_4 , but it may prove to be more distinctive when upper teeth are known.

MARSUPIALIA

DIDELPHIDAE

***PERADECTES* Matthew and Granger, 1921**

TYPE.—*P. elegans* Matthew and Granger.

DISTRIBUTION.—Tiffany, Colorado.

DIAGNOSIS.¹—Primitive and generalized didelphines. Dental formula $\frac{? . 1. 3. 4.}{74. 1. 3. 4.}$. Canine moderate, P_1 very small, apparently with only one root. P_3 slightly larger than P_2 . M^{1-3} trigonal, paracones nearly as large as metacones, broad outer shelf, five distinct stylar cusps of nearly equal size, proto- and metaconules distinguishable but vestigial, no basal cingula on protocone. M_4 reduced, transverse, paracone slightly larger than metacone. Lower molars of completely didelphine pattern. Trigonids elevated, paraconids distinctly higher than entoconids. M_4 as long as M_3 but narrower and heel reduced.

Some of the characters of this genus were mentioned incidentally by me in a previous note (Simpson 1928) and outline drawings of some parts given. In all its characters the genus is extraordinarily like recent opossums, and especially the various diminutive species of *Marmosa*,

¹Modified from Matthew and Granger.

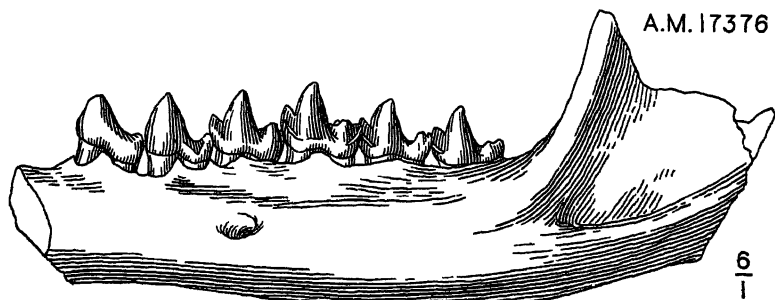


Fig. 1. *Peradectes elegans* Matthew and Granger. Type, Amer. Mus. No. 17376. Left lower jaw with P_2 - M_4 . External view. Enlarged six diameters.

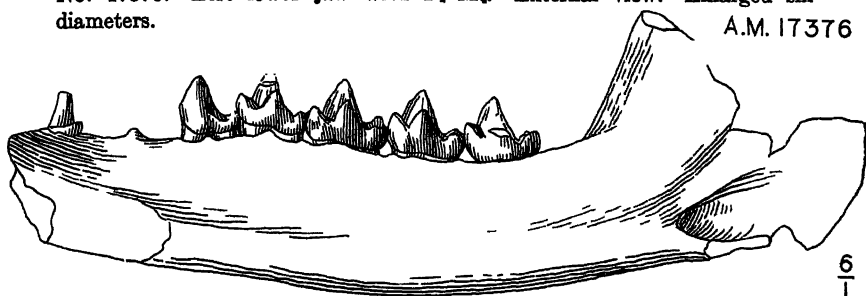


Fig. 2. *Peradectes elegans* Matthew and Granger. Type, Amer. Mus. No. 17376. Right lower jaw with P_1 and P_3 - M_4 . Internal view. Enlarged six diameters.

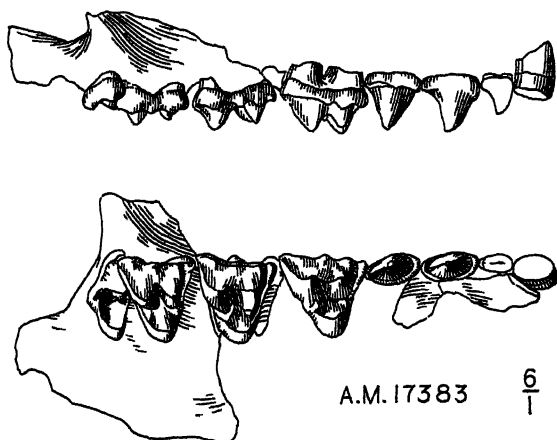


Fig. 3. *Peradectes elegans* Matthew and Granger. Amer. Mus. No. 17383. Right upper jaw with C and P^2 - M^4 , with P^1 (in outline) supplied from Amer. Mus. No. 17382. External and crown views. Enlarged six diameters.

and is an ideal structural ancestor with the doubtful exception of the greater reduction of P_1 . The most noteworthy other distinctions are the less differentiated styler cusps, less reduced paracones, and more elevated trigonids of the Paleocene genus.

The upper incisors are unknown. The canine is a slender, moderately large, vertically implanted tooth, very much as in *Marmosa*. There are no diastemata in the upper maxillary series. P^1 is a very simple, two-rooted tooth, laterally compressed, with a minute posterior but no anterior basal cuspule. P^{2-3} are subequal but P^2 slightly larger, strongly compressed and trenchant, with anterior and posterior basal cuspules, and surrounded by a basal cingulum which is, however, weaker and inconstant on P^2 . The enlargement of P^2 relative to P^3 is characteristic of modern didelphids (although not invariable in *Marmosa*), but is generally absent in the Eocene to Miocene *Peratherium*, and it is interesting to see it established in this very ancient genus, if only in barely noticeable, incipient fashion.

The upper molars are very like those of *Marmosa* except for the details already mentioned. On M^1 the third (middle) styler cusp is usually slightly highest. On M^2 the second to fourth are nearly equal, the third may be very slightly highest or may be a little lower than the second and fourth. On M^3 the third seems to be constantly smaller than the subequal second and fourth. M^4 has a strong parastylar spur, terminating in a style, and there may be two vague and minute styles on the sharp outer margin as it runs to the metacone.

Amer. Mus. No. 17403 has three small incisors. Although no other is preserved, it may be assumed with great probability that there were four and that these are I_{2-4} . I_{2-3} are subequal and have low, blunt, spatulate crowns. I_4 is not well seen, but appears to be much smaller. The lower canine, like the upper, is very suggestive of *Marmosa*. P_1 is a very small tooth, apparently with only one root: the only suggestion of aberrant specialization in the genus (and such a character may not be of more than specific value). P_{2-3} are compressed, trenchant teeth with elevated anterior cusps, that of P_3 about as high as the protoconid of M_1 , and that of P_2 very slightly higher. Each has a low, one-cusped posterior heel. On P_2 the posterior trenchant crest curves more directly to the posterior basal point while on P_3 a more distinct notch cuts off the larger talonid cuspule from the main part of the tooth. The lower molars are so simple and thoroughly didelphine as to require no further notice.

Part of the palate is preserved, very poorly, in one specimen but it shows nothing of special interest beyond a generally *Marmosa*-like character (fenestration present but size and shape not determinable). The mandible also appears to be as in the more delicate species of *Marmosa*. The relatively large posterior mental foramen is beneath M_1 . The position of the anterior foramen cannot be determined.

***Peradectes elegans* Matthew and Granger, 1921**

TYPE.—Amer. Mus. No. 17376, pair of lower jaws with right P_1 and P_3-M_4 and left P_2-M_4 .

PARATYPE.—Amer. Mus. No. 17369, left M^{1-4} .

HORIZON AND LOCALITY.—Mason Pocket, Tiffany Beds, Colorado.

DIAGNOSIS.—Sole known species of genus. Measurements are given below.

P_1-M_4 (type): 10.8 mm.

M_1-M_4 (type): 6.2 mm.

P^1-M^4 (Amer. Mus. No. 17382): about 10.5 mm.

M^1-M^4 (paratype): 5.3 mm.

M^1-M^4 (Amer. Mus. No. 17382): about 5.7 mm.

INSECTIVORA

LEPTICTIDAE

***Leptacodon* Matthew and Granger, 1921**

TYPE.—*L. tener* Matthew and Granger.

DISTRIBUTION.—Tiffany, Colorado. Fort Union, "Princeton Quarry Level," Park County, Wyoming. Bear Creek, Montana.

DIAGNOSIS.— P_4 with small metaconid, high on crown, partly connate with protoconid, paraconid low but as strong as on molars, talonid small, narrow, internal. Molar trigonids less elevated than in *Diacodon*, paraconids distinct but small, internal. Heel of M_3 with three subequal cusps, hypoconulid projecting but not excluded from basin. Protoconids nearly equal to metaconids, or slightly higher. Lower molars reduced in size from first to third.

This is a typically leptictine genus differing from *Diacodon* only in minute details, notably the slightly less progressive P_4 with smaller heel, less elevated molar trigonids, more internal paraconids, and shorter and simpler heel of M_3 .

In 1928 I described *Leipsanolestes siegfriedti* from Bear Creek, Montana, comparing it with the European *Adapisorex*. Discovery of better material and Teilhard's restudy of *Adapisorex* showed that *Leipsanolestes* is more closely related to *Leptacodon* and I later (1929) made

¹The brief diagnosis by Matthew and Granger was later emended by me (Simpson 1929, p. 118). The present diagnosis is a slight further emendation from further study and the discovery of specimens of the genus at other localities.

it a subgenus of the latter. There is some question as to the propriety of distinguishing genera on such slight differences as those supposedly characterizing *Diacodon*, *Prodiacodon*, and *Leptacodon*, emphasized by the discovery of the variant species *Leptacodon packi* and *Diacodon minutus* by Jepsen. It is unlikely that all these, with *Leptacodon* (*Leipsanolestes*), belong to one genus, but it is by no means clear that the genera are, or can be, now properly defined or that the lines between them are properly drawn.

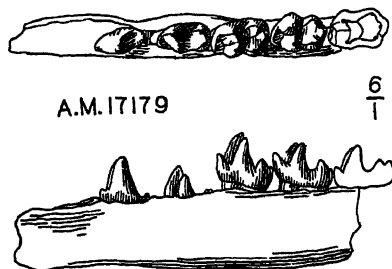


Fig. 4. *Leptacodon tener* Matthew and Granger. Type, Amer. Mus. No. 17179. Right lower jaw with P_3 - M_2 , with M_3 (in outline) supplied from Amer. Mus. No. 17395. Crown and internal views. Enlarged six diameters.

The slight variation from typical and very well-known leptictid structure and the detailed description of *L. packi* by Jepsen (1930, pp. 510-511) make extended description of the dentition unnecessary.

***Leptacodon tener* Matthew and Granger, 1921**

TYPE.—Amer. Mus. No. 17179, crushed skull and jaws (most parts very obscure but P_3 - M_2 well shown).

HORIZON AND LOCALITY.—Mason Pocket, Tiffany, Colorado.

DIAGNOSIS.—Length M_{1-3} , 4.3 mm. Trigonid of P_4 relatively low. Protoconid about equal to metaconid on M_1 , slightly lower on M_{2-3} . Hypoconids all slightly larger than entoconids. Hypoconulids projecting, that of M_3 prominently so. Molar cusps slender.

L. tener and *L. packi* are of almost exactly the same size and are so similar that they are not well distinguished, although probably different. Wear, crushing, and differences in individual observation particularly obscure the proper comparison of these small species, and nothing is actually known as to their range of variation. *L. siegfriedti* is also closely similar but is definitely larger and more robust and otherwise seems more distinctive.

XENACODON Matthew and Granger, 1921

TYPE.—*X. mutilatus* Matthew and Granger.

DISTRIBUTION.—Tiffany, Colorado.

DIAGNOSIS.—Dental formula $73.1.4.3$. Incisors small. Canine small, followed by very short diastema. All premolars two-rooted. P_4 with large metaconid about equal to protoconid, paraconid small, basal, talonid very short and not or very indistinctly basined. On M_{2-3} trigonid less elevated than in *Prodiacodon*, protoconid slightly larger than metaconid; hypoconid large, united in a crest with hypoconulid, entoconid very small, more isolated, and conical. Talonid of M_3 reduced, short and very narrow, hypoconulid not projecting.

The only specimen is of a young individual, with P_4 just being erupted. From the alveoli, dm_3 was either still in place or had been lost a very short time. M_3 is, however, fully erupted and beginning to wear—this late loss of the deciduous teeth is common in leptictids.

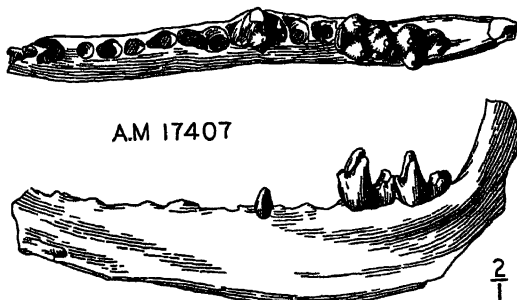


Fig. 5. *Xenacodon mutilatus* Matthew and Granger. Type, Amer. Mus. No. 17407. Right lower jaw with P_4 and M_{2-3} . Crown and internal views. Enlarged six diameters.

The alveoli are obscure, but there were probably three small incisors. P_1 occupied almost as much space as P_2 . The transverse heel crest of P_4 seems to have two closely approximated cusps, but they can hardly be distinguished. The paraconids of M_{2-3} are small, but quite distinct and are about halfway between the primitive anterointernal position and the anteromedian site which they occupy in many more aberrant early mammals. That of M_3 seems to project somewhat more strongly from the trigonid, an unusual character perhaps due only to wear on M_2 . The horizontal ramus is very slender, but this may be merely a juvenile character to the extent that it differs from most leptictids. There is a mental foramen beneath P_1 and another, larger, beneath the anterior end of P_3 .

¹Emended from Matthew and Granger.

The general habitus is very leptictid, much like *Prodiacodon* ("Paleolestes"), for instance, and there is a definite resemblance in molar structure. This, however, seems to me somewhat less marked than was suggested by Matthew and Granger. The talonids, for instance, are distinctive. Except for being partly molariform, P_4 is very unlike that of any other leptictid. The position of *Xenacodon* in this family is thus not certain, but it is probable and no more satisfactory arrangement is suggested.

***Xenacodon mutilatus* Matthew and Granger, 1921**

TYPE.—Amer. Mus. No. 17407, right lower jaw with P_4 , M_{2+3} , and alveoli of the other teeth.

HORIZON AND LOCALITY.—Mason Pocket, Tiffany Beds, Colorado.

DIAGNOSIS.—Sole known species of the genus as defined above. M_2 , length 3.5 mm., width 3.1 mm. M_3 , length 3.7 mm., width 2.3 mm.

?CHIROPTERA

?PHYLLOSTOMATIDAE

***ZANYCTERIS* Matthew, 1917**

TYPE.—*Z. paleocena* Matthew.

DISTRIBUTION.—Tiffany, Colorado.

DIAGNOSIS.¹—Dental formula ^{2.1.3.3}. Incisors not determinable. Canine small, laterally compressed, with posterior, but no anterior, cutting crest. Canine followed by diastema. Alveoli of each premolar occupying about same space as that of canine, anteroposterior. Alveoli of P^2 confluent, those of P^3 imperfectly separated, those of P^4 distinct, posterior larger. M^1 very large, M^{2+3} progressively much smaller. Molar contour transitional from nearly triangular, M^1 , to subquadrate, M^3 . Crowns broadly basined with rugose enamel. Paracone, metacone, and protocone distinct but low and marginal save for external cingula. M^{2+3} with hypocone suggested but not distinctly cuspidate. M^1 with anterointernal and large posterointernal cingula. Muzzle narrowing rapidly anterior to molars, elongated. Cranium short and broad. Zygoma probably complete, arising at the junction of M^1 and M^2 . Sagittal crest low.

The unique specimen is a nearly complete skull, but so badly crushed that no details can be made out beyond the general shape of the palate and muzzle and the less definite and few additional points mentioned in the diagnosis.

The small canine is not perfectly oval in section, but it is less elongate, less enlarged, and generally much less specialized than in the modern forms of most nearly comparable molar pattern. It is a simple tooth, the crown very slightly procumbent, swollen and oval except for

¹Slightly modified from Matthew.

a poorly developed posterior vertical crest and a slight excavation on the inner (lingual) side of this. This is followed by a diastema approximately equal to the canine root in length, and then by the three closely spaced premolars, the crowns of which are not preserved.

The very large first molar is subtriangular, but the inner part is rounded out by its cingula so as to form a semicircle inscribing the inner angle of the triangle formed by the protocone. The greater part of the crown is occupied by a broad, shallow basin with markedly rugose or pitted enamel. Protocone, paracone, and metacone are of about equal height, but the protocone is more prominent, being more isolated and with a more expanded base. The paracone and metacone are far apart, being nearly at the extreme angles of the long outer border, but are united by a sharp crest, which waves slightly outward in the middle, suggesting a very vague mesostyle. Less distinct crests run from the protocone to the paracone and to the metacone, but these are depressed near the longitudinal midline, so that the tooth has, rather vaguely, a broad longitudinal median groove. There is a low, distinct style directly anterior to the paracone, and a strong external cingulum which, however, does not cross the outer face of the paracone. This cingulum rises slightly to form a median style¹ and again to form a vaguely double elevation external to the metacone. The protocone is anterior in position, and hence nearer the paracone than the metacone. No internal cingulum crosses its base, but there is a small, basined, anterointernal basal cingulum, and a larger, basined cingulum originating at the tip of the protocone and sweeping around the posterointernal side of the tooth.

M² is less triangular, the protocone directly internal to the paracone, and the protocone-metacone ridge curving first posteriorly, then externally, filling out the posterointernal angle but not forming a definite cusp. There is not, as on M¹, a cingulum crest or basin below this ridge, but the anterointernal cingulum is present, although minute. The external cingulum does cross the paracone, being widest here and developing a style external to the paracone (there is none anterior to the latter) and another, very indefinite, near the midpoint. The cingulum dies out on reaching the base of the metacone.

The diminutive M³ is definitely quadrate, the crest from protocone to metacone being still more expanded and definitely angulate, with a

¹It is noteworthy that mesostyles, in a topographic sense, may have at least two quite different origins. They may represent an outgrowth or angulation of the paracone-metacone crest, or ectoloph, or they may grow up on the margin of an external cingulum. In this animal both types of mesostyle are vaguely indicated.

tendency to form a vague cusp at the posterointernal angle. The protocone is completely anterior, without any basal cingula. The external cingulum is short and slight and bounds only a small median basin between paracone and metacone, which are still about equal.

As Matthew pointed out (1917) the only known mammals which this extraordinary form approaches at all closely are the more specialized members of the Phyllostomatidae, the subfamilies Sturnirinae, Stenoderminae, and Phyllonycterinae of Miller's classification. *Zanycteris* cannot be said to have any diagnostic characters of the Chiroptera as a whole. Indeed, its general habitus, as far as determinable, is definitely non-chiropteran, for instance in the anterior position of the zygomata, the marked constriction of the skull anterior to them, the relatively slender and elongate muzzle, and the weak, simple canines. The purely anteroposterior P^4 , the great enlargement of M^1 , and the post-canine diastema are not unknown among Chiroptera but are the exception rather than the rule in that Order. The loss of P^1 is highly characteristic of recent bats, but occurs in so many other orders that it is in no sense diagnostic.

The reference of *Zanycteris* to the Chiroptera depends, then, on a general, not very detailed resemblance of its molars to those of a few recent genera which are in this respect highly aberrant and the most specialized of all known members of the Order. The principal elements of this resemblance, every item of which is a distinction from primitive Chiroptera or from the Chiroptera in general, are:

Enlargement of M^1 (not, however, so marked in the recent genera in question).

Presence of a broad, shallow basin, tending to form a longitudinal valley.

Roughened enamel of basin.

Marginal position of cusps, their lack of distinctness, and the loss of the typical V-shape of the outer cusps of other Chiroptera.

Tendency to form a hypocone (or "pseudohypocone") by diversion and angulation of the protocone-metacone crest (but the hypocone does not arise this way in all the recent genera in question and may not in any, although it sometimes appears to).

The indication of affinities is not very convincing, and it is entirely possible that *Zanycteris* is not a chiropteran, but no other comparison can be suggested. If it is a bat, then it had already reached, or even in some details surpassed, the highest grade of aberrant specialization in the molars shown by recent bats, without (as far as shown) having acquired other chiropteran characteristics. It must be assumed, if it is

¹A term which I find misleading and prefer not to employ, although it is rather deeply embedded in the literature.

considered chiropteran, to be especially related to the aberrant phyllostomatids, for if its characters do not indicate such highly special relationships they do not indicate chiropteran affinities at all.

With the very doubtful exception of a Lower Eocene specimen described by Cope, since lost, and really of unknown affinities, *Zanycteris* is the only supposed bat known from the Western Hemisphere before the Pleistocene, although it is, of course, certain *a priori* that the bats did occur here during the Tertiary.

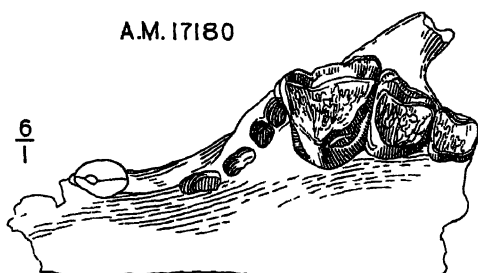


Fig. 6. *Zanycteris paleocena* Matthew. Type, Amer. Mus. No. 17180. Left upper jaw with M^{1-3} , with the canine (in outline) supplied from the right side of the same individual. Crown view. Enlarged six diameters.

Zanycteris paleocena Matthew, 1917¹

Palaeonycteris paleocena WEBER AND ABEL, 1928 ('Die Säugetiere,' 2 Aufl. 2 Bd., p. 159), in error.

TYPE.—Amer. Mus. No. 17180, skull, very poorly preserved except most of palate, with right canine and M^{1-3} of both sides.

HORIZON AND LOCALITY.—Mason Pocket, Tiffany Beds. Colorado.

DIAGNOSIS.—Sole known species of genus as defined above. See also measurements below.

M^{1-3}4.2 mm.

C			M^1			M^2			M^3	
L		L	W		L	W		L	W	
0.8		2.2	2.0		1.3	1.7		0.9	1.1	

¹The trivial name has hitherto been written "*paleocenus*" but is emended to agree in gender with the generic name. *Nukreps* is feminine, and so are Latin nouns in *-ris*. It seems unjustified to consider *paleocenus* as one of the very exceptional Latin adjectives (e.g., *velus*) with a feminine in *-us*. Within the spirit of the rules, such emendations are required and do not alter authorship.

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DISTRIBUTIONAL AND PHYLOGENETIC STUDIES ON INDIAN FOSSIL MAMMALS. I

AMERICAN MUSEUM COLLECTING LOCALITIES IN NORTHERN INDIA

By EDWIN H. COLBERT

INTRODUCTION

This is one of a series of papers by the present author setting forth the results of a prolonged study of the collection of Siwalik mammals in The American Museum of Natural History. Eight papers by the writer, descriptive of new or little-known Siwalik mammals in the American Museum collection, have preceded the present contribution, and in addition to these eight papers there have been several papers by other authors dealing with Siwalik fossils in the American Museum. All of these foregoing papers necessarily serve as a partial basis for the study now being offered, and also for an extended monograph, to appear in the near future, which will be concerned with a detailed presentation of researches on the American Museum Siwalik collection.

This and several succeeding papers will epitomize certain aspects of the results obtained from the study of the Siwalik mammals in the American Museum. It has been thought advisable to bring out these contributions antecedent to the large volume, in order that some of the results of particular interest, arising from the Siwalik study, might be made generally available.

I wish to express my appreciation to the Geological Survey of India for permission to reproduce portions of certain geologic maps furnished by them. The maps appearing in this paper were traced from the Indian Survey maps by D. F. Levett Bradley. The charts and diagrams in the following papers were prepared by Margaret Matthew Colbert and D. F. Levett Bradley.

The collection of Siwalik fossils in the American Museum was made by Dr. Barnum Brown, who worked in the Punjab from the latter part of 1921 until the beginning of 1923. During this time a large series of remains of fossil vertebrates was obtained from the Siwalik Series of Upper Tertiary and Lower Pleistocene age. These fossils were found in two general areas, one in the Salt Range between the Jhelum and the

Indus rivers and the other in the Siwalik Hills, between the Sutlej and the Jumna rivers.

The specimens making up the American Museum Siwalik collection were obtained at various levels in the Siwalik Series, and they are representative of the three great Siwalik faunas, namely that of the Lower Siwaliks, that of the Middle Siwaliks, and that of the Upper Siwaliks. The specimens obtained from the first of the two general areas mentioned above are mostly of Lower and Middle Siwalik age, while the specimens collected in the Siwalik Hills are of Upper Siwalik age. By far the greatest number of these specimens are representative of the Mammalia, and these have been the concern of the study now being set forth in this series of papers.

THE IMPORTANCE OF EXACT RECORDS FOR FOSSILS

The collection of Siwalik mammals in the American Museum is especially valuable in that it was made with special regard for exact records of localities and geologic levels. During the course of his field work in the Punjab, Dr. Brown carried a set of topographic sheets, and on these he located as accurately as possible the localities at which fossils were discovered. In his field notes he made records of the stratigraphic occurrences of these fossils. Naturally these careful field records have aided greatly in a proper interpretation of the relations of the several Siwalik faunas, each to the other.

There has been an ever increasing realization of the importance of careful and exact field records for collections of fossils, and as a result palaeontologists and stratigraphers have been devoting an increasing amount of time and care to the compilation of complete records as to localities and stratigraphic levels as an adjunct to collecting expeditions. Geographic and stratigraphic notes of the greatest detail are especially desirable for fossil mammals discovered in continental Tertiary and Quaternary beds, where sedimentary variations are numerous and evolution is rapid.

With these considerations in mind, Dr. Brown kept careful and accurate field records of his collecting localities, as pointed out above, and from his records the maps accompanying this report have been prepared. These maps are published in order that students using the American Museum collection, or the publications dealing with this collection, may locate the positions of the specimens comprising the collection, not only with regard to their geographic occurrences, but also with reference to their stratigraphic positions.

EXPLANATION OF MAPS

The maps figured on the accompanying pages were drawn up from Indian Geological Survey topographic sheets, on which the geologic formations had been drawn in and colored by members of the Indian Survey. Credit for the geographic and geologic data appearing on these maps should go to the Geological Survey of India.

The first map (Fig. 1) is a general outline map of India, on which is shown the two areas, marked A and B respectively, in which Dr. Brown made the collections of Siwalik mammals for the American Museum.

The two succeeding maps (Figs. 2 and 3) are enlargements of the areas A and B of Fig. 1. On these two maps are marked the numbers and the locations of certain Indian Survey topographic sheets from which the succeeding maps were made. Furthermore, on the two maps under discussion, there are certain areas marked by a stippled design, and these represent the exact locations of the nine detailed maps which follow.

The nine detailed maps (Figs. 4 to 12 inclusive) have been prepared to include most of the localities at which mammalian fossils were discovered by Dr. Brown. An *Hipparion* was found at Hari Talyangar, and a few specimens were discovered at Ramnagar in Kashmir, but it was not thought advisable to prepare separate sheets for these isolated occurrences.

These maps are on a scale of one inch to two miles. The boundaries of the geologic formations are marked by heavy lines, and the several stratigraphic units enclosed within these lines are indicated by certain letters, in the following manner.

<i>Ral</i>	Recent	—Alluvium
<i>Qus</i>	Quaternary	—Upper Siwaliks
<i>Tms</i>	Tertiary	—Middle Siwaliks
<i>Tch</i>	Tertiary	—Lower Siwaliks, Chinji zone
<i>Tka</i>	Tertiary	—Lower Siwaliks, Kamliak zone

The stratigraphic classification used on these maps is that followed by the Indian Geological Survey, according to the official usage of that organization.

The localities at which Dr. Brown obtained the fossils in the American Museum Siwalik collection are indicated by numbers accompanying circles. These are the field numbers used by Dr. Brown in his field notebook. Numbers 1 to 102 inclusive were located by Dr. Brown on topographic sheets when he was in the field, and they represent exact localities at which fossils were found. Numbers 103 to 164 inclusive represent localities that were noted by Dr. Brown in his field records,

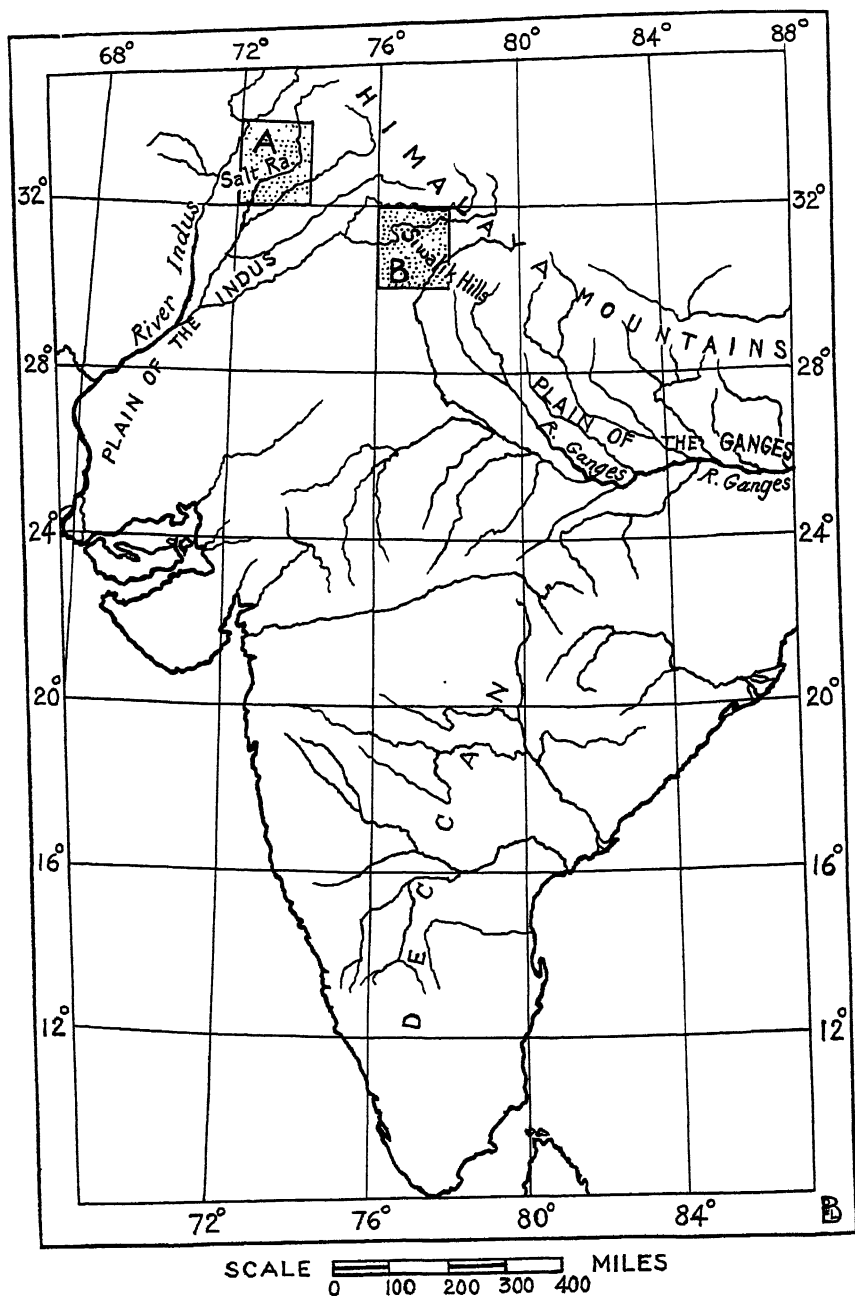


Fig. 1. Map of India, showing location of two key maps, A and B, which include the localities from whence the American Museum Siwalik collection was obtained.

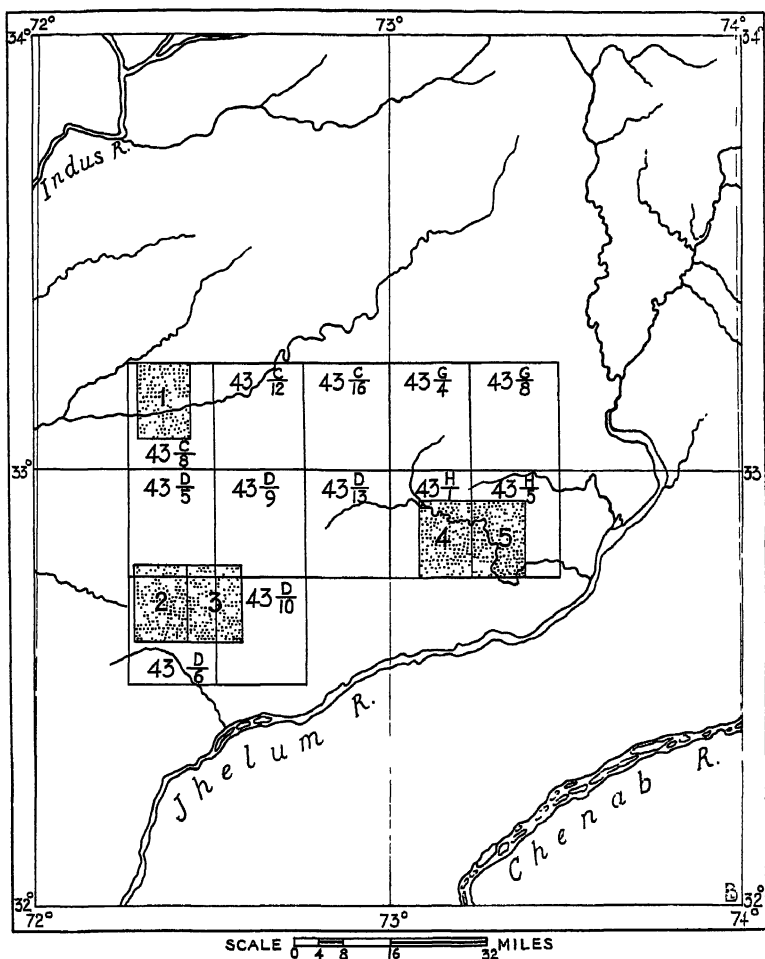


Fig. 2. Key map A (see Fig. 1). This is in the Salt Range area, near the headwaters of the Indus, the Jhelum, and the Chenab rivers. On this map certain Indian Geological Survey sheets are indicated by rectangles and by numbers (43 C/8, 43 C/12, etc.). The stippled rectangles, numbered 1 to 5 inclusive, are the specific areas from which fossils in the American Museum Siwalik collection were obtained. These rectangles (1 to 5) are reproduced in detail in Figs. 4 to 8 inclusive. Scale, 1 inch equals thirty-two miles.

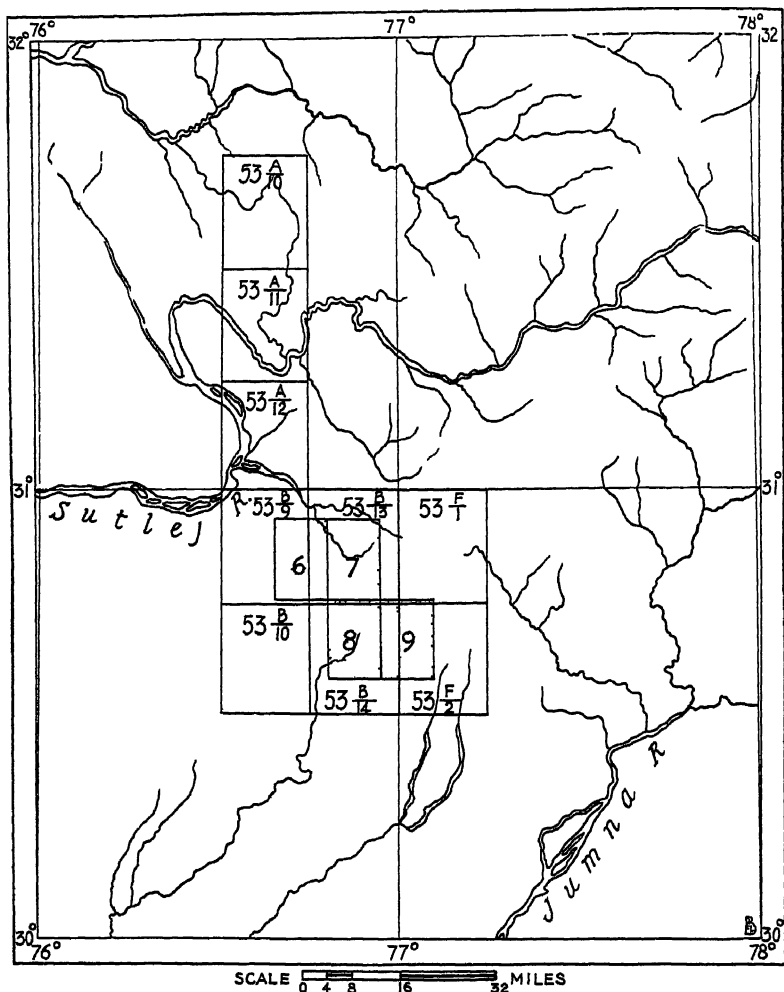


Fig. 3. Key map B (see Fig. 1). This is in the Siwalik Hills region, in the upper reaches of the Sutlej and the Jumna rivers. Indian Geological Survey sheets and stippled rectangles are indicated as in key map A. The stippled rectangles (6 to 9, inclusive) are reproduced in detail in Figs. 9 to 12 inclusive. Scale, 1 inch equals thirty-two miles.

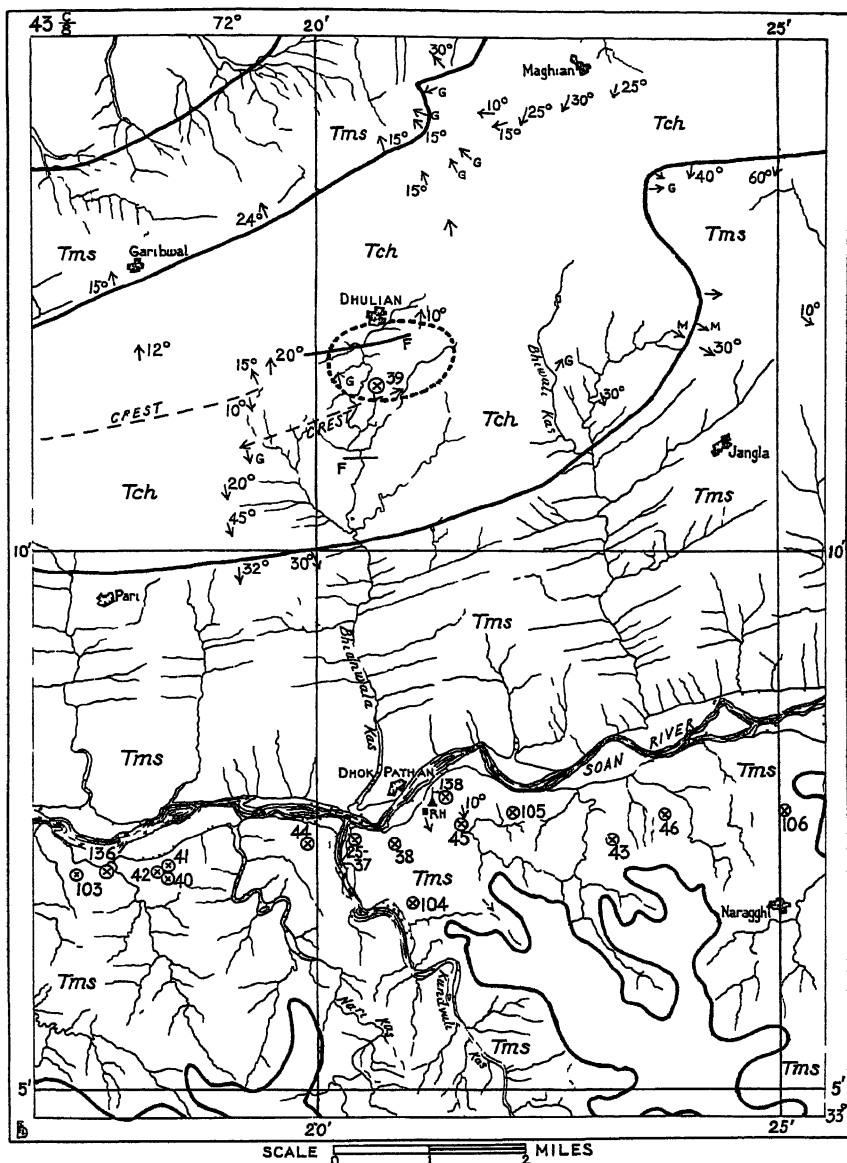


Fig. 4. Rectangle No. 1 of key map A. The region around Dhok Pathan and Dhulian. American Museum fossil localities shown by x, enclosed in circles, with accompanying numbers. Scale, one inch equals two miles.

Tms = Tertiary, Middle Siwaliks; Tch = Tertiary, Chinji (Lower Siwaliks).

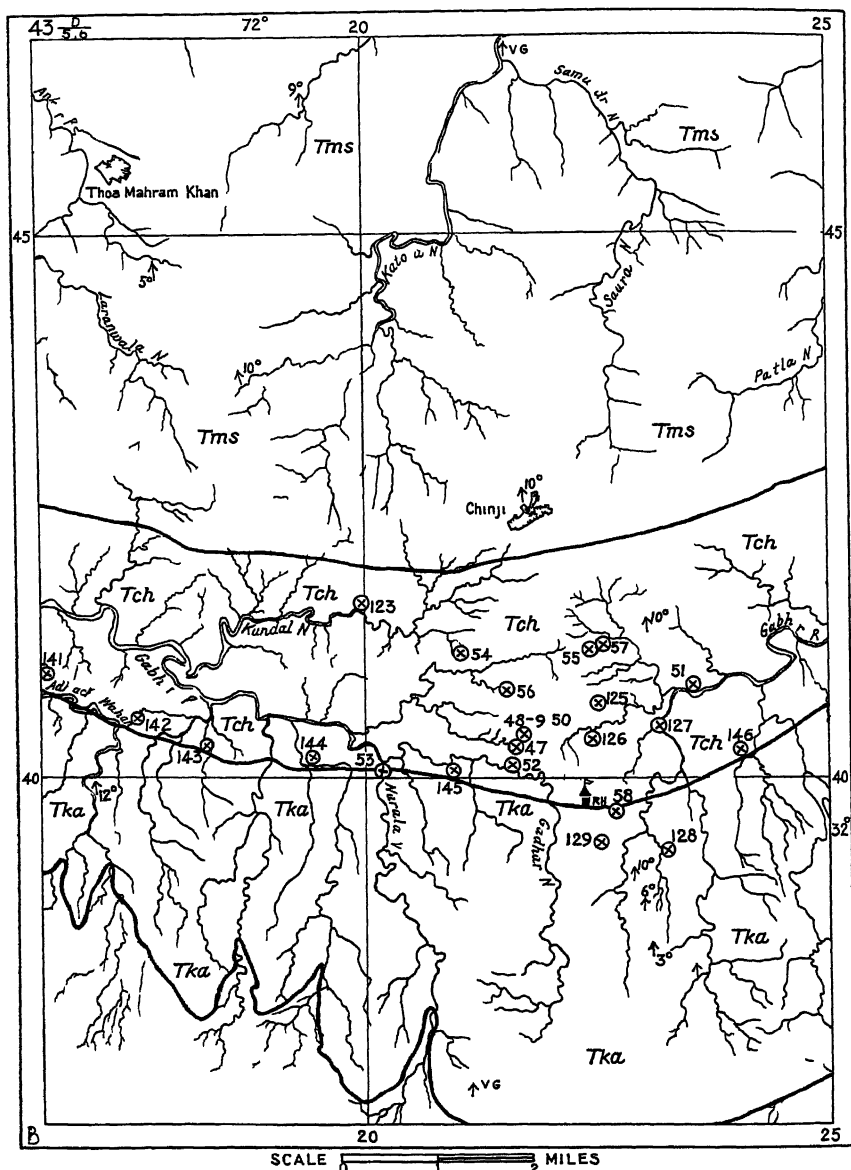


Fig 5 Rectangle No 2 of key map A The region south of Chinji Scale, one inch equals two miles

Tms = Tertiary Middle Siwaliks Tch = Tertiary Chinji (Lower Siwaliks) Tka = Tertiary Kamhal (Lower Siwaliks)

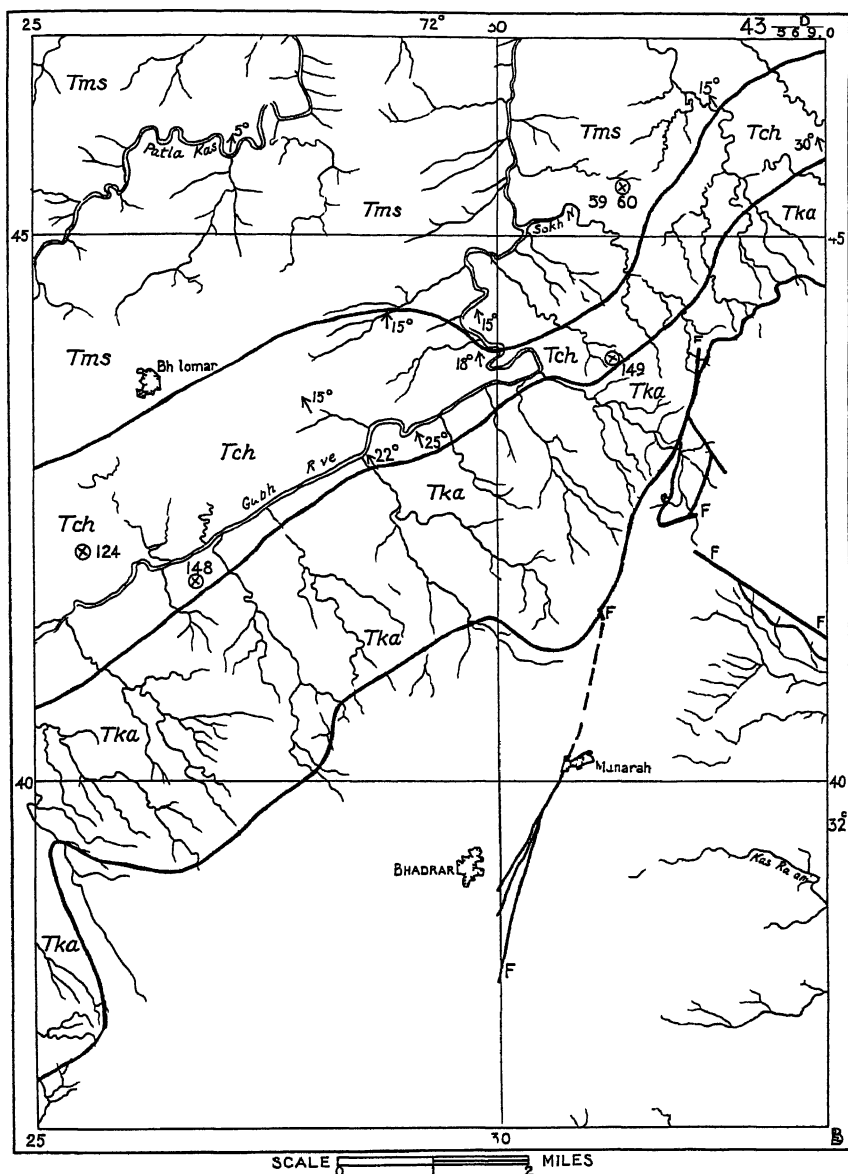


Fig 6 Rectangle No 3 of key map A The region east of Chinji Scale, one inch equals two miles

Tms = Tertiary Middle Siwaliks *Tch* = Tertiary Chinji (Lower Siwaliks) *Tka* = Tertiary Kamhal (Lower Siwaliks)

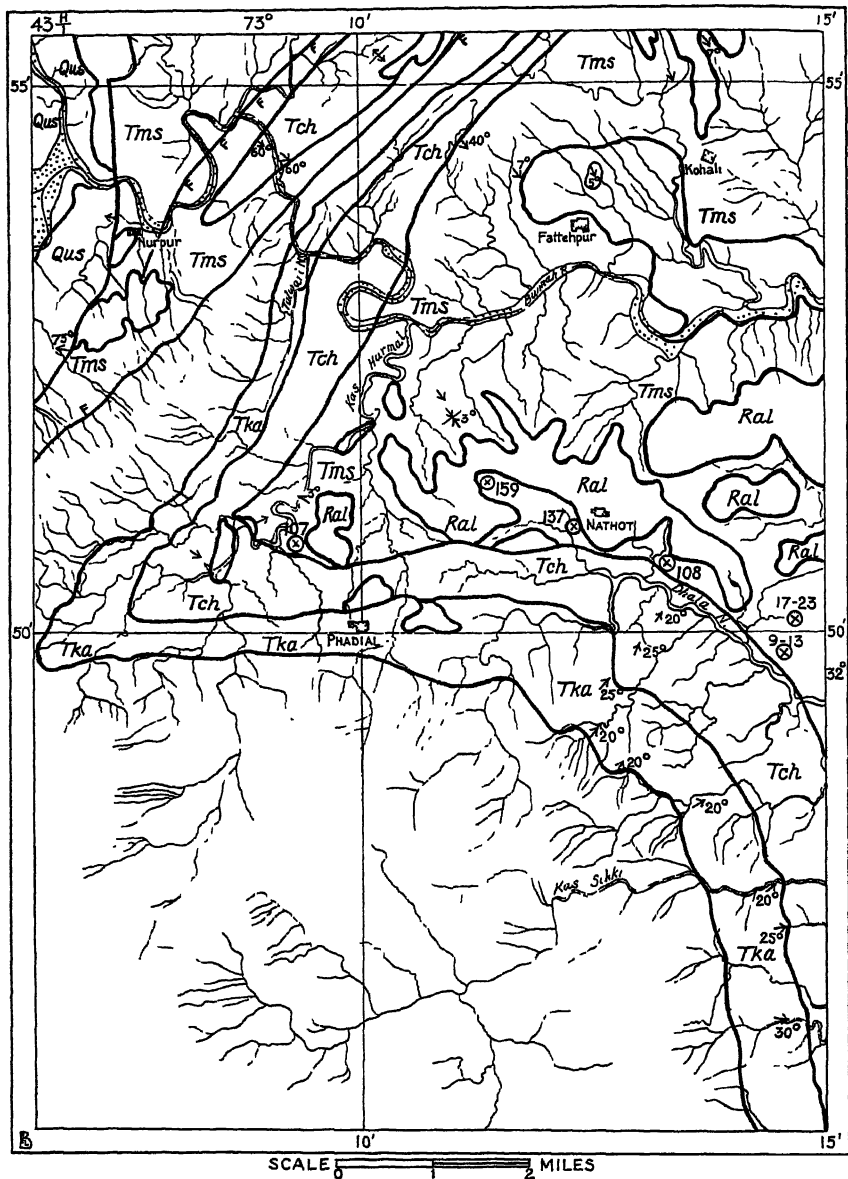


Fig. 7. Rectangle No. 4 of key map A. The region around Nathot. Scale, one inch equals two miles.

Ral = Recent, alluvium; *Qus* = Quaternary, Upper Siwaliks; *Tms* = Tertiary, Middle Siwaliks; *Tch* = Tertiary, Chinji (Lower Siwaliks); *Tka* = Tertiary, Kamli (Lower Siwaliks).

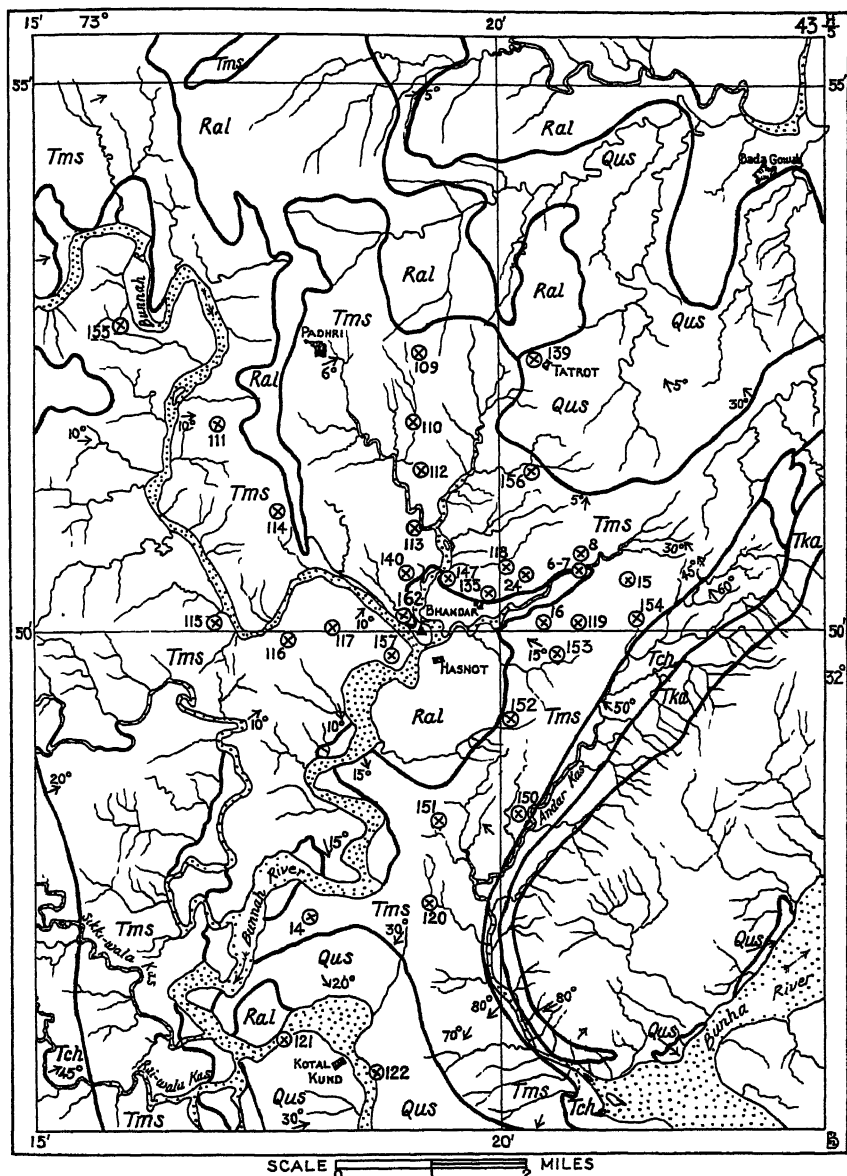


Fig. 8. Rectangle No. 5 of key map A. The region around Hasnot. Scale, one inch equals two miles.

Ral = Recent, alluvium; *Qus* = Quaternary, Upper Siwaliks; *Tms* = Tertiary, Middle Siwaliks, *Tch* = Tertiary, Chinji (Lower Siwaliks); *Tka* = Tertiary, Kamial, (Lower Siwaliks).

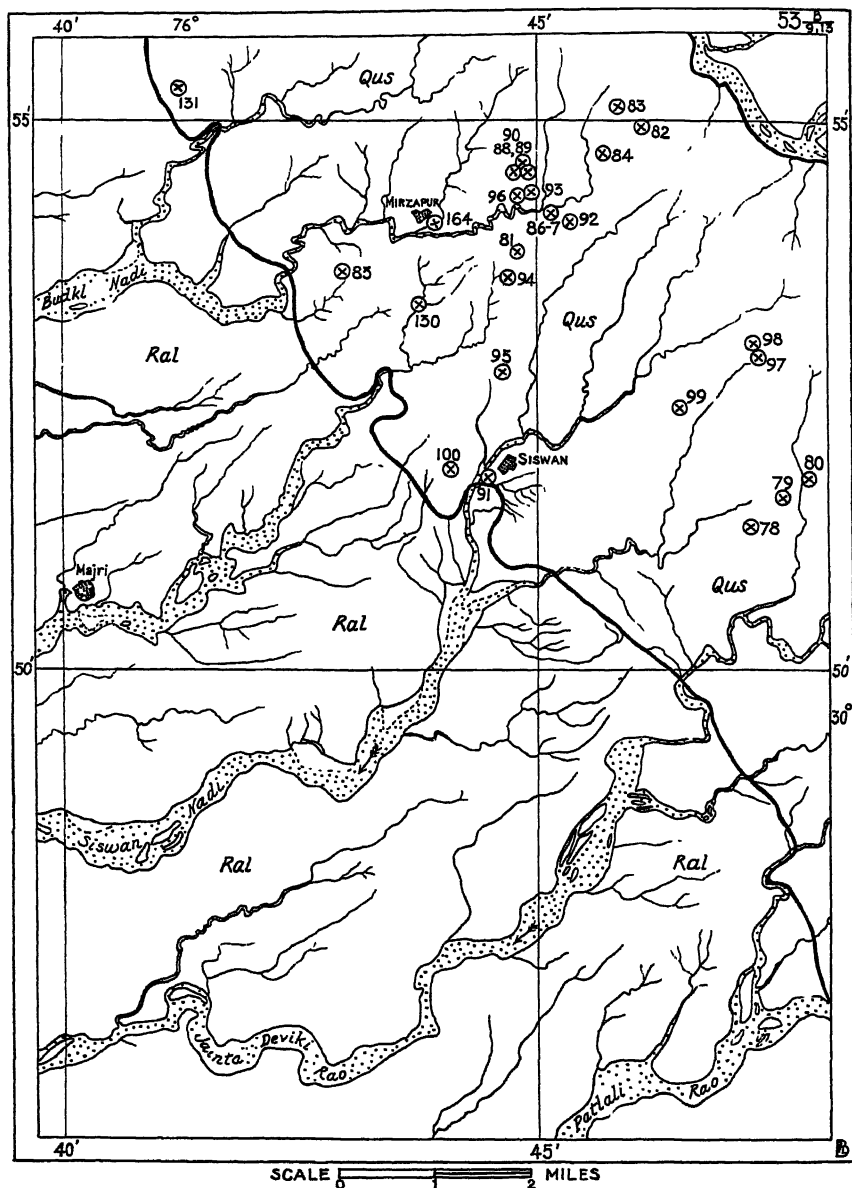


Fig. 9. Rectangle No. 6 of key map B. The region around Siswan. Scale, one inch equals two miles.

Ral = Recent, alluvium; *Qus* = Quaternary, Upper Siwaliks.

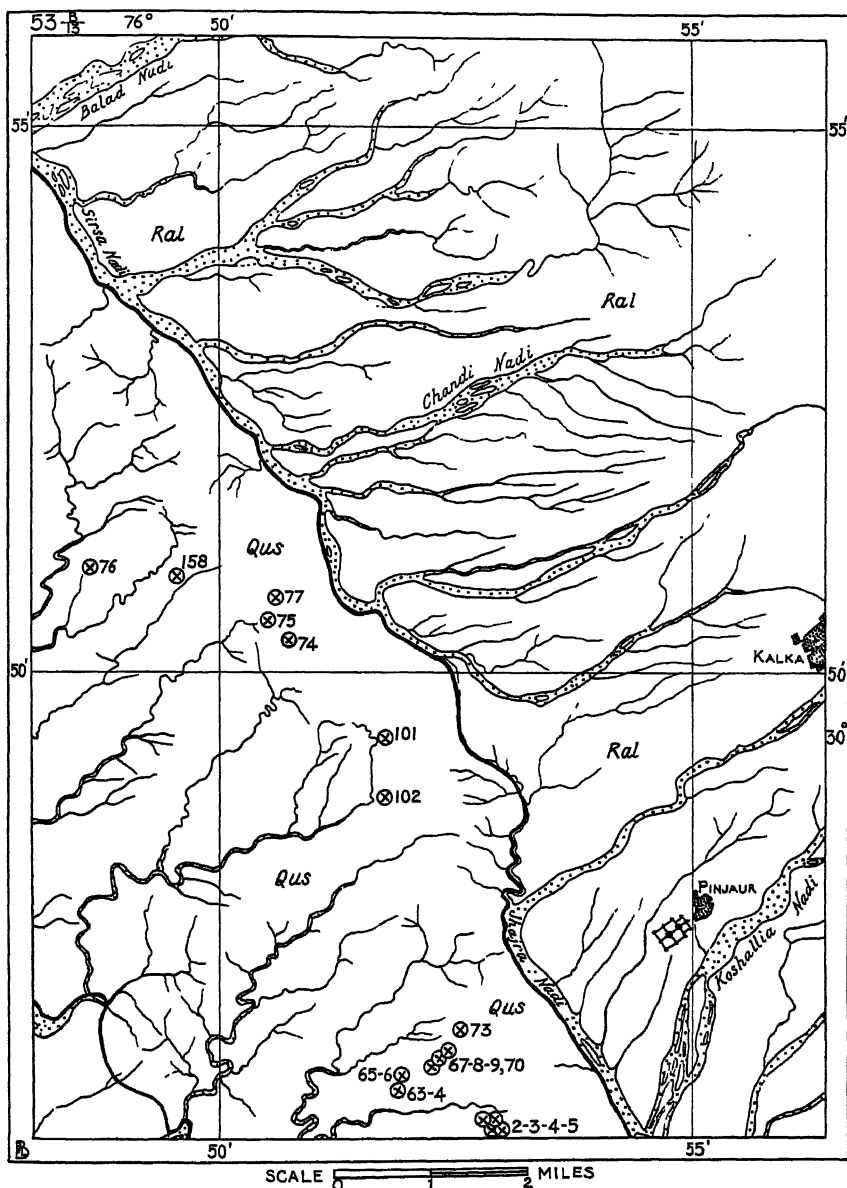


Fig. 10. Rectangle No. 7 of key map B. The region around Pinjaur. Scale, one inch equals two miles.

Ral = Recent, alluvium; *Qus* = Quaternary, Upper Siwalika.

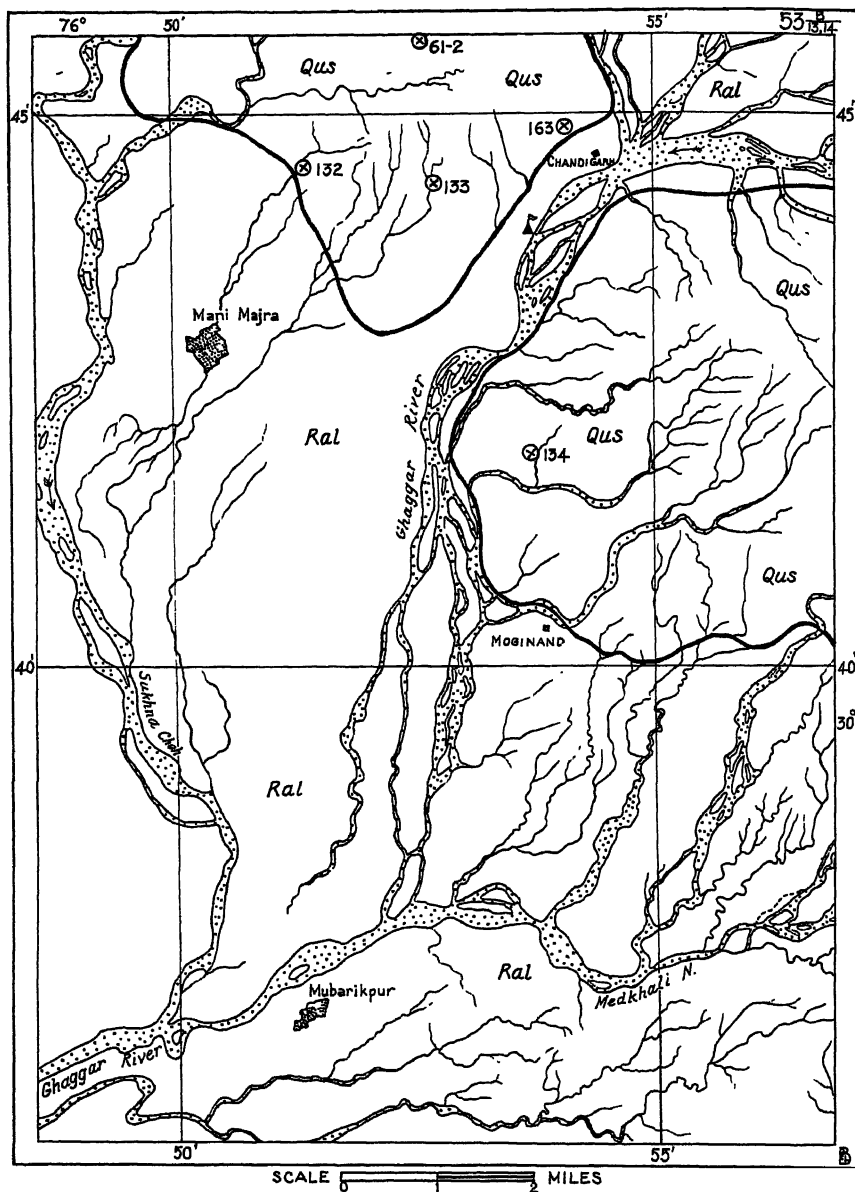


Fig. 11. Rectangle No. 8 of key map B. The region around Chandigarh. Scale, one inch equals two miles.

Ral = Recent, alluvium; *Qus* = Quaternary, Upper Siwaliks.

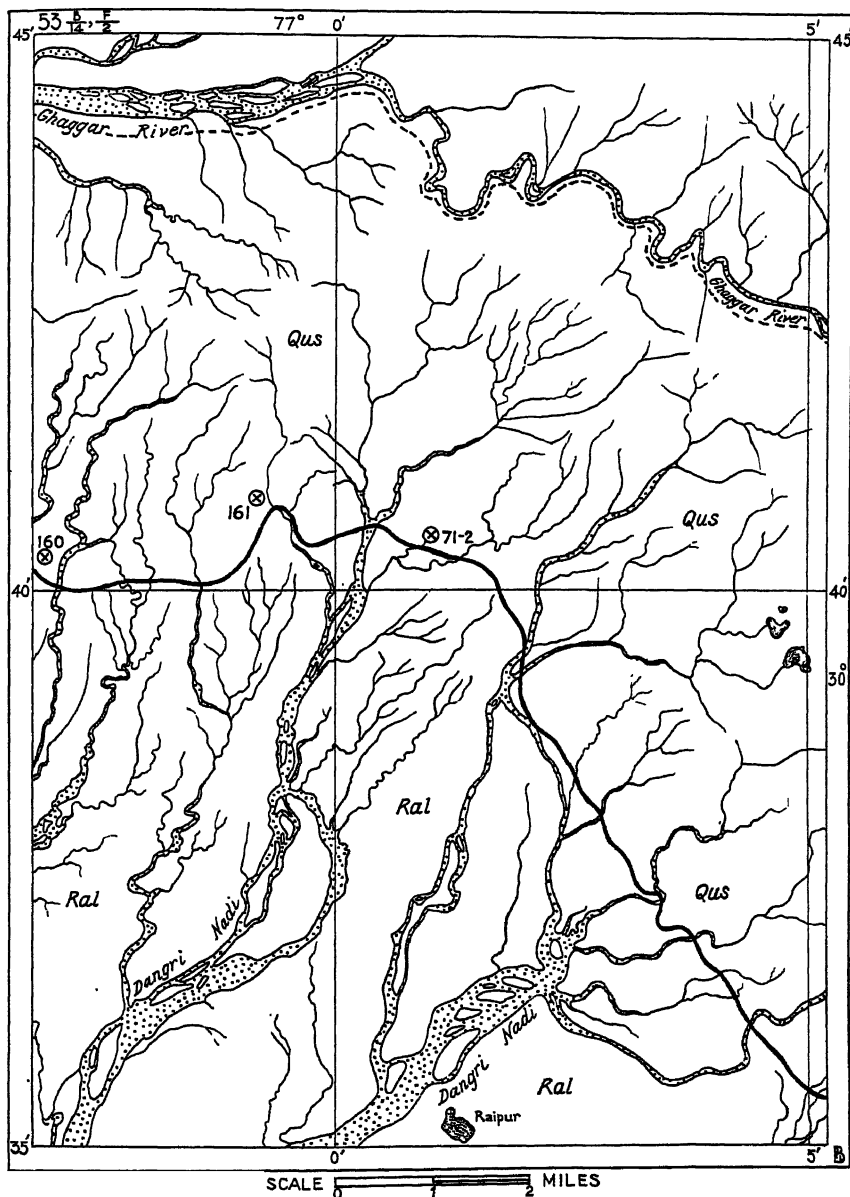


Fig. 12. Rectangle No. 9 of key map B. The region east of Chandigarh. Scale, one inch equals two miles.

Ral = Recent, alluvium; *Qus* = Quaternary, Upper Siwaliks.

but which were not placed on the maps at the time he was in the field. They have been subsequently located, according to the data contained in the field notebook, and naturally their positions are not as exactly determined as are those of the first group of numbers.

With these detailed maps, showing the locations of the boundaries of the several Siwalik divisions, and placing the positions where fossils were discovered, it is possible to fix all of the specimens in the American Museum collection, not only as regards their geographic positions but also as regards the approximate stratigraphic level of each.

EXPLANATION OF LOCALITY LIST

The following list gives the locations and the stratigraphic positions of the one hundred and sixty-four fossil localities which appear on the nine detailed maps (Figs. 4 to 12 inclusive). The localities and their stratigraphic levels are given as they were set down in Dr. Brown's field notebook. In a few cases there are seeming discrepancies between the locality as it is recorded and as it is actually placed on the map, and likewise between the stratigraphic level as recorded in the notebook and as indicated on the map. These supposed discrepancies are due to the fact that it was necessary for Dr. Brown to estimate distances, and these estimated distances often apply to measurement along a trail rather than in a direct line. The positions of fossil localities as indicated on the maps are to be regarded as accurate. Estimates of levels are based on the careful observations of stratigraphic sequences.

LOCALITY LIST

FIELD NUMBER	LEVEL	LOCATION
1	Middle Siwaliks	Near Haritalyangar
2, 3, 4, 5	Upper Siwaliks, top of variegated beds below conglomerate	3 miles north west of Chandigarh
6, 7	Upper portion of Middle Siwaliks	1 1/2 miles north east of Hasnot
8	Middle Siwaliks, 100 feet above Bhandar bone bed	1 1/2 miles northeast of Hasnot
9-13	Middle Siwaliks, 1000 feet below Bhandar bone bed	4 1/2 miles west of Hasnot
14	Upper Siwaliks, lower part	3 1/2 miles northwest of Kotal Kund
15	Middle Siwaliks, upper part	2 miles northeast of Hasnot
16	Middle Siwaliks, upper part	1 mile northeast of Hasnot
17-23	Middle Siwaliks, 1000 feet below Bhandar bone bed	4 1/2 miles west of Hasnot
24	Middle Siwaliks, upper part	1/2 mile northeast of Bhandar

LOCALITY LIST (*Continued*)

FIELD NUMBER	LEVEL	LOCATION
25-37	Middle Siwaliks, upper part	1/2 mile southwest of Dhok Pathan
38	Middle Siwaliks, upper part	1 mile south of Dhok Pathan
39	Lower Siwaliks, 3000 feet below Dhok Pathan quarry	Dhulian Dome, 6 miles north of Dhok Pathan
40	Middle Siwaliks, upper part	3 miles west of Dhok Pathan
41, 42	Middle Siwaliks, upper part	3 miles west of Dhok Pathan
43	Middle Siwaliks, upper part	2 miles east of Dhok Pathan
44	Middle Siwaliks, upper part	1 mile west of Dhok Pathan
45	Middle Siwaliks, upper part	1/2 mile east of Dhok Pathan
46	Middle Siwaliks, upper part	3 miles east of Dhok Pathan
47	Lower Siwaliks, 1100 feet above Chinji Rest House	1 mile northwest of Chinji Rest House
48-50	Lower Siwaliks, 1600 feet above Chinji R. H.	1 mile northwest of Chinji R. H.
51	Lower Siwaliks, 400 feet above Chinji R. H.	1 1/2 miles northeast of Chinji R. H.
52	Lower Siwaliks, 400 feet above Chinji R. H.	1 mile west of Chinji R. H.
53, 54	Lower Siwaliks	2 miles west of Chinji R. H.
55	Lower Siwaliks, 1600 feet above Chinji R. H.	1 1/2 miles north of Chinji R. H.
56	Lower Siwaliks, 1600 feet above Chinji R. H.	1 1/2 miles northwest of Chinji R. H.
57	Lower Siwaliks, 1600 feet above Chinji R. H.	1 1/2 miles north of Chinji R. H.
58	Lower Siwaliks, 100 feet below Chinji R. H.	At Chinji R. H.
59, 60	Lower Siwaliks, 1600 feet above Chinji R. H.	12 miles east of Chinji R. H.
61, 62	Upper Siwaliks, below conglomerate	2 miles west of Chandigarh
63-70	Upper Siwaliks, below conglomerate	3 miles west of Chandigarh
71, 72	Upper Siwaliks, below conglomerate	15 miles east of Chandigarh
73	Upper Siwaliks, below conglomerate	3 miles west of Chandigarh
74, 75	Upper Siwaliks, below conglomerate	6 miles west of Kalka
76	Upper Siwaliks, below conglomerate	8 miles west of Kalka
77	Upper Siwaliks, below conglomerate	6 miles west of Kalka
78-80	Upper Siwaliks, below conglomerate	9 miles west of Kalka
81	Upper Siwaliks, upper clays below conglomerate	1 mile east of Mirzapur
82-84	Upper Siwaliks, upper clays below conglomerate	3 miles northeast of Mirzapur
85	Upper Siwaliks, upper clays below conglomerate	1 mile southwest of Mirzapur
86-87	Upper Siwaliks, upper clays below conglomerate	3 miles north of Siswan

LOCALITY LIST (*Continued*)

FIELD NUMBER	LEVEL	LOCATION
88	Upper Siwaliks, upper clays below conglomerate	3 miles north of Siswan
89	Upper Siwaliks, upper clays below conglomerate	3 miles north of Siswan
90	Upper Siwaliks, upper clays below conglomerate	3 miles north of Siswan
91	Upper Siwaliks, base of conglomerate	Siswan
92	Upper Siwaliks, below conglomerate	3 miles north of Siswan
93	Upper Siwaliks, below conglomerate	3 miles north of Siswan
94	Upper Siwaliks, below conglomerate	2 miles north Siswan
95	Upper Siwaliks, below conglomerate	1 mile north of Siswan
96	Upper Siwaliks, below conglomerate	1 mile east of Mirzapur
97, 98	Upper Siwaliks, below conglomerate	3 miles northeast of Siswan
99	Upper Siwaliks, below conglomerate	2 miles northeast of Siswan
100	Upper Siwaliks, near top of conglomerate	1/2 mile west of Siswan
101	Upper Siwaliks, below conglomerate	2 miles south of Charnian
102	Upper Siwaliks, below conglomerate	2 1/2 miles south of Charnian
103	Middle Siwaliks, upper part	4 miles west of Dhok Pathan
104	Middle Siwaliks, upper part	1 mile south of Dhok Pathan
105	Middle Siwaliks, upper part	1 mile east of Dhok Pathan
106	Middle Siwaliks, upper part	4 miles east of Dhok Pathan
107	Middle Siwaliks, lower part	1/2 mile west of Phadial
108	Middle Siwaliks, 200 feet lower than Nos. 17-23	1 mile south of Nathot
109	Middle Siwaliks, (?) upper part, or Upper Siwaliks (?) lower part	3 miles north of Hasnot
110	Middle Siwaliks, upper part	2 miles north of Hasnot
111	Middle Siwaliks, upper part	3 miles northwest of Hasnot
112	Middle Siwaliks, upper part	1 1/2 miles north of Hasnot
113	Middle Siwaliks, upper part	1 mile north of Hasnot
114	Middle Siwaliks, upper part	2 miles northwest of Hasnot
115	Middle Siwaliks, 500 feet below Bhandar bone bed	2 miles west of Hasnot
116	Middle Siwaliks, 500 feet below Bhandar bone bed	1 1/2 miles west of Hasnot
117	Middle Siwaliks, upper part	1 mile west of Hasnot
118	Middle Siwaliks, upper part	1 mile northeast of Hasnot
119	Middle Siwaliks, upper part	1 1/2 miles east of Hasnot
120	Middle Siwaliks, upper part, or Upper Siwaliks, lower part	3 miles south of Hasnot
121	Upper Siwaliks	1/2 mile northwest of Kotal Kund
122	Upper Siwaliks	1/2 mile east of Kotal Kund
123	Lower Siwaliks, 1600 feet above Chinji R. H.	3 miles northwest of Chinji R. H.

LOCALITY LIST (*Continued*)

FIELD NUMBER	LEVEL	LOCATION
124	Lower Siwaliks, level of Chinji R. H.	4 miles northeast of Chinji R. H.
125	Lower Siwaliks, 600 feet above Chinji R. H.	1 mile north of Chinji R. H.
126	Lower Siwaliks, 200 feet above Chinji R. H.	1/2 mile north of Chinji R. H.
127	Lower Siwaliks, 100 feet above Chinji R. H.	1 mile northeast of Chinji R. H.
128	Base of Lower Siwaliks	1 mile southeast of Chinji R. H.
129	Lower Siwaliks, 100 feet below Chinji R. H.	1/2 mile south of Chinji R. H.
130	Upper Siwaliks, middle of conglomerate	1 mile south of Mirzapur
131	Upper Siwaliks, below conglomerate	4 miles west of Mirzapur
132	Upper Siwaliks, below conglomerate	3 miles west of Chandigarh
133	Upper Siwaliks, below conglomerate	1 mile west of Chandigarh
134	Upper Siwaliks, below conglomerate	2 1/2 miles south of Chandigarh
135	Middle Siwaliks, 100 feet above bone bed	At Bhandar
136	Middle Siwaliks, same level as No. 40	3 1/2 miles west of Dhok Pathan
137	Middle Siwaliks, near base	Near Nathot
138	Middle Siwaliks, upper part	Near Dhok Pathan
139	Middle Siwaliks, upper part, or Upper Siwaliks, lower part	At Tatrot
140	Middle Siwaliks, upper part	1/2 mile north of Hasnot
141	Lower Siwaliks	6 miles west of Chinji
142	Lower Siwaliks	5 miles west of Chinji
143	Lower Siwaliks, 100 feet above Chinji R. H.	4 miles west of Chinji
144	Lower Siwaliks, 400 feet above Chinji R. H.	3 miles west of Chinji R. H.
145	Lower Siwaliks, 500 feet above Chinji R. H.	1 1/2 miles west of Chinji R. H.
146	Lower Siwaliks	1 1/2 miles east of Chinji R. H.
147	Middle Siwaliks, upper part	1/2 mile northeast of Hasnot
148	Lower Siwaliks	5 miles east of Chinji R. H.
149	Lower Siwaliks	10 miles east of Chinji R. H.
150	Middle Siwaliks, near base	2 miles south of Hasnot
151	Middle Siwaliks, upper part	2 miles south of Hasnot
152	Middle Siwaliks	1/2 mile southeast of Hasnot
153	Middle Siwaliks, 200 feet below Bhandar bone bed	1 mile east of Hasnot
154	Middle Siwaliks, upper part	2 miles east of Hasnot
155	Middle Siwaliks, 100 feet below Bhandar bone bed	4 1/2 miles northwest of Hasnot

LOCALITY LIST (*Continued*)

FIELD NUMBER	LEVEL	LOCATION
156	Middle Siwaliks, upper part	2 1/2 miles northeast of Hasnot
157	Middle Siwaliks, upper part	1/2 mile southwest of Hasnot
158	Upper Siwaliks	7 miles west of Kalka
159	Middle Siwaliks, lower part	2 miles northeast of Phadial
160	Upper Siwaliks, below conglomerate	6 miles east of Chandigarh
161	Upper Siwaliks, below conglomerate	12 miles east of Chandigarh
162	Middle Siwaliks, upper part	At Hasnot
163	Upper Siwaliks	At Chandigarh
164	Upper Siwaliks, below conglomerate	At Mirzapur

NOTE.—Numbers 14, 59, and 60 are located on the accompanying maps in the positions recorded for them on the field maps. Evidently they are misplaced. Number 14 should be in the Upper Siwaliks, numbers 59 and 60 in the Lower Siwaliks.

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DISTRIBUTIONAL AND PHYLOGENETIC STUDIES ON INDIAN FOSSIL MAMMALS. II

THE CORRELATION OF THE SIWALIKS OF INDIA AS INFERRED BY
THE MIGRATIONS OF *HIPPARION* AND *EQUUS*

BY EDWIN H. COLBERT

INTRODUCTION

Since the first studies of Hugh Falconer and Proby T. Cautley on the Siwalik mammals of India, numerous authors have been interested in the question of the age of the beds in which these mammals were found. A proper knowledge of the age of the Siwalik deposits is essential for a proper understanding of the rich mammalian faunas contained within them, not only because these faunas show successive evolutionary stages in a definitely limited region, but also because these faunas are closely related to other fossil faunas in other sections of Eurasia and North America.

The authors who have been especially concerned with the problem of the correlation of the Siwalik deposits are Hugh Falconer, Richard Lydekker, Guy E. Pilgrim, and W. D. Matthew. As the results of their separate studies of this problem, these students arrived at varying opinions regarding the age of the Siwalik Series, which of course is not surprising, since their collective studies extended over a period of almost one hundred years, and during this time an ever increasing amount of information about Siwalik stratigraphy and Siwalik faunas came to light.

A protracted study of the collection of Siwalik mammals in The American Museum of Natural History has afforded additional evidence bearing on the problem of Siwalik correlation. Therefore it has been thought advisable to publish this paper as an expression of the conclusions reached by the present author regarding the age of the Siwalik Series. The arguments presented below are based not only on the detailed study of the fossils in the American Museum Siwalik collection, but also on observations made in the field by Dr. Barnum Brown, when he was gathering this collection together. The lucid discussions by Dr. Matthew on the question of the correlation of the Siwaliks have been of inestimable value in the preparation of the following remarks.

COMPARATIVE VIEWS OF SIWALIK CORRELATION

It may be well at this point to consider briefly the several views advocated by the above-mentioned authors as to the correlation of the Siwalik deposits.

Hugh Falconer, the first student of Siwalik mammals, knew only the Upper Siwalik fauna, and this he considered as of Miocene age. Richard Lydekker was acquainted with two Siwalik faunas, namely the Upper one, known to Falconer, and the Middle one. He came to the conclusion that both of these faunas might be placed within the Pliocene period, the Upper Siwalik fauna being of Upper Pliocene age and the Middle Siwalik fauna (designated by Lydekker as the Lower fauna) being of Lower Pliocene age.

The discoveries made by Dr. G. E. Pilgrim first brought the true Lower Siwalik fauna to light. As the result of his studies, especially on the basis of a comparison of Siwalik with Eurasiatic faunas, Dr. Pilgrim came to the conclusion that the Lower Siwalik fauna is of Upper Miocene age, the Middle Siwalik fauna of Lower Pliocene or Pontian age, and the Upper Siwalik fauna of uppermost Pliocene or lowermost Pleistocene age. Working on the lines of different evidence, especially that of the intercontinental migrations of fossil horses, Dr. W. D. Matthew came to somewhat different conclusions from Pilgrim as to the age of the Siwalik faunas. He considered the typical Lower Siwalik fauna to be of Lower Pliocene or Pontian age, the Middle Siwalik fauna to be of post-Pontian age, and the Upper Siwalik fauna to be of Lower Pleistocene age. My own studies of the several Siwalik faunas substantiates Dr. Matthew's opinion.

A chart, showing the comparative views as to the correlation of the Siwaliks, accompanies this discussion.

THE AGE OF THE LOWER AND MIDDLE SIWALIKS AS INFERRED BY THE INTERCONTINENTAL MIGRATION OF *Hipparion*

Various lines of evidence tend to make the problem of Siwalik correlation a confusing one, and naturally such a situation has led to differences of opinion among the students of Siwalik faunal successions, as pointed out above. Two methods of attack have been followed in the attempted solution of the perplexing question as to the age of the Siwalik deposits; these are stated below.

1.—The several Siwalik faunas have been studied on the merits of their general aspects, and have accordingly been compared directly with

COMPARATIVE VIEWS OF SIWALIK CORRELATION							
	FALCONER	LYDEKKER	PILGRIM	MATTHEW	COLBERT	EQUIVALENTS	
						EUROPEAN	AMERICAN
PLEISTOCENE							
PLIOCENE							
MIOCENE							

Fig. 1. Comparative views of Siwalik correlation.

the similar faunas of eastern Europe and of Asia. This is the method that has been followed by Dr. Pilgrim.

2.—The Siwalik faunas have been compared not only to the faunas of Europe and Asia, but also to those of North America, and particular attention has been given to the appearances of certain forms invading the Indian region from the North American region. This was the method followed by Dr. Matthew.

Now when the Siwalik faunas are compared directly with similar European or Asiatic faunas, the evidence seems to be greatly in favor of Dr. Pilgrim's views of correlation. The Lower Siwalik fauna is rather distinctly Miocene in its general aspect, for it contains various species of *Dryopithecus*, an hyaenodont (obviously a hold over from earlier times), primitive felids, mastodonts, *Listriodon* and other relatively primitive pigs, a rather primitive anthracothere, *Macrotherium*, and primitive bovids.

In a like manner the typical Middle Siwalik fauna from the Dhok Pathan area shows Pontian affinities. It has Pontian carnivores, *Orycteropus*, closely comparable to *O. gaudryi*, advanced mastodonts, *Hipparion*, *Chilotherium*, *Aceratherium*, rather advanced suids and anthracotheres, cervids, large giraffids, and Pontian bovids. The Upper Siwalik fauna is composed of typical Lower Pleistocene carnivores, mammoths and ungulates. On the grounds of the evidence outlined above, there would seem to be ample justification of Dr. Pilgrim's arguments for the correlation of the Siwaliks.

An examination of the fossil horses, however, throws a somewhat different light on the question.

It is now definitely established, on the basis of the material collected by Dr. Brown, that *Hipparion* is present at the bottom of the Chinji beds, a fact that heretofore has been more or less in question. The importance of this fact will be brought out in the succeeding paragraphs.

The results of many years of exploration and research by various institutions in North America have proven beyond much doubt that the evolutionary history of the Equidae went through all of its major important phases in North America. Moreover, a careful study of the Upper Tertiary Equinae of North America conclusively shows that the genus *Hipparion* has been derived directly from the genus *Merychippus*. There is a gradual and a perfect gradation in the teeth, skulls, and skeletons from the advanced species of *Merychippus*, typical of the Upper Miocene, into the most primitive species of *Hipparion*, typical of the Lower Pliocene of North America.

The characteristic Middle Miocene species of *Merychippus* are medium-sized equines with three toes on each foot, the lateral ones of which do not reach the ground. The upper cheek teeth are rather short-crowned and have square crowns, invested with cement. The enamel borders are relatively simple and the protocone is connected to the protoloph. *Merychippus sejunctus* or *Merychippus isonesus* are typical of the Middle Miocene species of the genus. In the Upper Miocene, a considerable amount of progression is shown over the characteristic Middle Miocene types. The Upper Miocene species, such as *Merychippus republicanus*, are somewhat larger than the older forms, and the teeth are more advanced. The upper cheek teeth are longer crowned, with more complicated enamel foldings, and the protocone tends to be separated from the protoloph in the unworn posterior molars.

Now in the most primitive Lower Pliocene species of *Hipparion* in North America, such as *Hipparion gratum*, a remarkable similarity to the advanced species of *Merychippus* is evident. These primitive forms of *Hipparion* are relatively small, no larger than the advanced *Merychippus*, the cheek teeth are rather short crowned and square, and in the worn molars the protocone is attached to the protoloph, notwithstanding the fact that a separate protocone is a diagnostic character of the genus *Hipparion*. Thus we see that the advanced habitus characters of the progressive species of *Merychippus* become the heritage characters in the primitive species of *Hipparion*. Indeed, the stages of the transition from the one genus into the other are so gradually graded that it is very difficult to draw a distinct line of demarcation between the two.

All of our evidence therefore points to the conclusion that *Hipparion* must have arisen in North America as a direct development from *Merychippus*, subsequently migrating to Asia and Europe. This was the view taken by Matthew, as revealed in the following statement.

"I conclude therefore that the Equinae are surely of American evolution and dispersal and appeared in the Old World as immigrant types."¹

Now the question arises as to when this migration took place. *Hipparion* first appears in the Valentine formation of North America, which may be regarded either as uppermost Miocene or basal Pliocene. The Valentine forms of *Hipparion*, as particularly exemplified by the species *Hipparion gratum*, are relatively primitive, of small size, with rather simple enamel foldings in the molars, and with the protocone attached to the protoloph in the worn upper cheek teeth.

¹Matthew, W. D. 1929. 'Critical Observations upon Siwalik Mammals,' Bull. Amer. Mus. Nat. Hist., LVI, p. 529.

On the other hand, the *Hipparion* found at the base of the Chinji beds is a well advanced form, in all respects comparable to *Hipparion theobaldi*, the typical Middle Siwalik species. It has large molar teeth, indicative of a large skull and body, the protocones of the molars are elongated and the enamel foldings of the fossette borders are complex. All in all, the Chinji *Hipparion* is more closely comparable to the American species from the Republican River or equivalent beds than it is to the earlier Valentine forms. This is what we might expect, because there would obviously be a certain time element involved during the migration of the genus from North America to Asia.

Hipparion occurs in Europe, according to Borissiak, at Sebastopol in Sarmatian times. Therefore, if we accept Borissiak's correlation of the Sebastopol deposits, it seems logical to regard the Sarmatian as no older than the Valentine of North America, and probably a little younger. At least, the Sarmatian may be the equivalent of the upper portion of the Valentine. Considering this to be the case, the Pontian would be about equivalent to the Republican River of North America, a view that was advocated by Matthew in 1929.

The base of the Chinji zone, since it contains an advanced *Hipparion*, can be no older than the Sarmatian, and it is very probably equivalent to the upper portion of the Sarmatian or the lower part of the Pontian. But here we meet a difficulty in that the Chinji fauna as a whole is typically more primitive than a Sarmatian or a Pontian fauna should be. The presence of *Hipparion* in the Chinji is, however, incontrovertible evidence against an older age for these beds, so it becomes necessary to regard the Chinji fauna as relict, stratigraphically of upper Sarmatian or lower Pontian age but homotaxially of more primitive affinities. Here we see a striking example of the importance of invading types in determining the age of a fauna. Autochthonous forms may linger on in a certain region, and thus they may be contemporaneous with the advanced invading types, coming into the region from an outside locality. But the invading types furnish the true key to the age of the fauna.

Various European authorities have considered *Hipparion* as of Old World origin, in the face of the very definite evidence to the contrary, outlined above. Of course if *Hipparion* were of Eurasiatic origin, Dr. Pilgrim's views as to the correlation of the Siwaliks would be fully justified. In fact, Pilgrim has considered the possibility not only of an Eurasiatic origin for *Hipparion*, but also the possibility that the genus may have appeared first in the Old World and subsequently in the New World. His views are well expressed in the following remarks, which

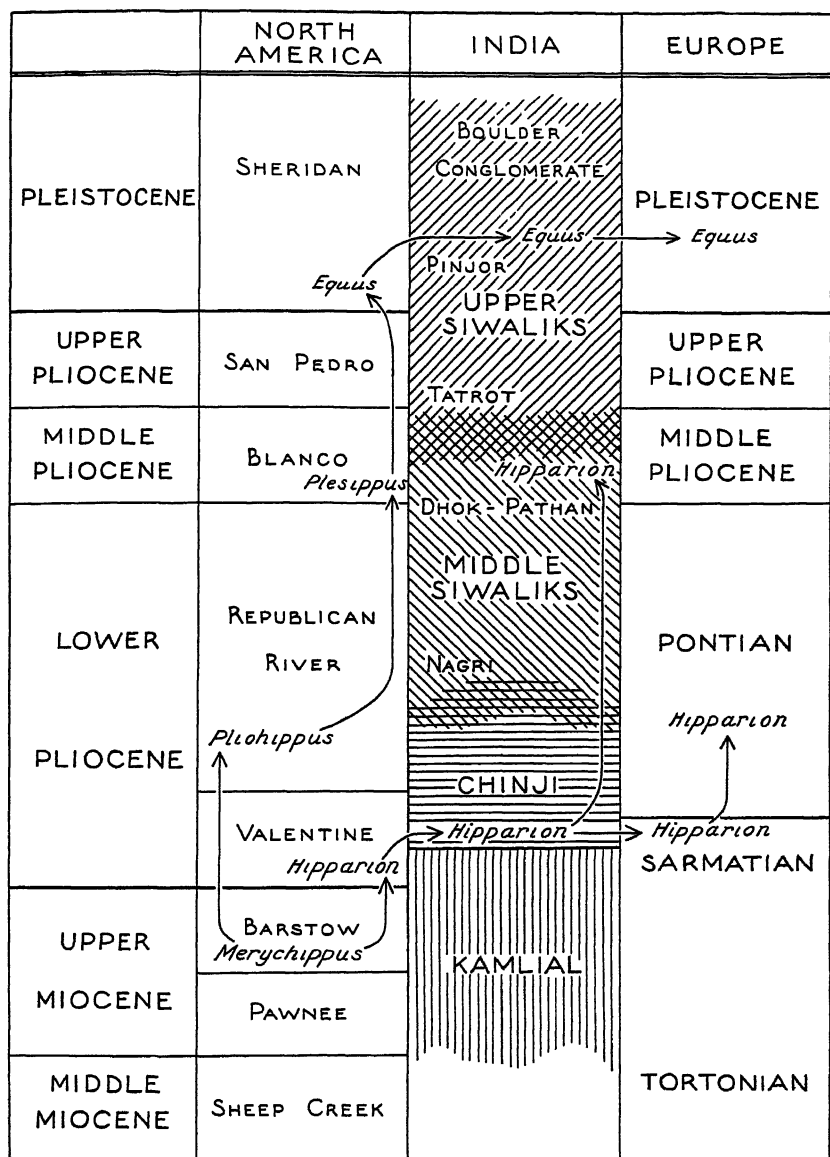


Fig. 2. The correlation of the Siwaliks, as based on the intercontinental migrations of the Upper Tertiary and Quaternary Equidae.

were contained in a private communication to the present author. I take the liberty of reproducing them here.

"The occurrence of *Hipparion* in the Lower Chinji certainly makes it more difficult to correlate that stage with the Tortonian of Europe. But I cannot see how one can disregard the evidence of a whole fauna because one cannot find an explanation of the occurrence of a single form. Questions of migration, character of the fauna, i.e., whether plains or forest enter into the problem of correlation in a way which Matthew himself has rendered abundantly clear. It is a fact that *Hipparion* occurs in Europe in the Sarmatian, and one cannot deny that it is possible that *Hipparion* may have occurred in Central Asia and India even previously to this. I am inclined to think myself that the *Hipparion* of the Old World may be distinct from and have predated the *Hipparion* of America. This has more behind it than mere supposition. The lateral digits of the Old World *Hipparion* are certainly stronger than those of the American *Hipparion*. Where are we to find the links between the earlier American forms and this *Hipparion* with strong lateral digits? Apparently not in America. Whether the lateral digits have been strengthened secondarily, as Matthew thinks, or are a relic of an earlier condition, as I think, does not in the least matter. The point is that somewhere or other the ancestral form of the *Hipparion* of Sebastopol and Pikermi must have existed, and since the American deposits are so well known that its presence could hardly escape notice there, it seems more likely that it will one day be found in the Old World. It may be that the Chinji form might even turn out to be the required link, since we do not know the foot. I cannot even regard it as proved that such a type of *Hipparion* did not live in Tung Gur times. Its absence proves nothing definite, since the fauna is of a forest rather than a plains type, and as such is more likely to have contained *Anchitherium* than *Hipparion*. The rest of the fauna shows nothing, so far as I am aware, which would militate against a Tortonian age, the equivalent of La Grive St. Alban."

The Tung Gur formation referred to by Dr. Pilgrim is an horizon of Upper Miocene age, probably correlative with the Sarmatian of Europe and the Pawnee Creek, Lower Snake Creek and Mascall of North America. See Colbert, E. H., 1934, Amer. Mus. Novitates, No. 690, pp. 5-6.

A reply to Dr. Pilgrim's arguments is presented in the following paragraphs.

As pointed out above, there is a perfect gradation from *Merychippus* into *Hipparion* in North America, and the primitive *Hipparion* of the New World is more primitive than the earliest Eurasiatic species. This

evidence obviates the necessity of supposing a separate origin for the Eurasiatic *Hipparion*.

In the preceding pages an attempt has been made to show that the evidence of a fauna can be outweighed by the evidence of immigrant forms. The Chinji fauna is a primitive persistent assemblage, but the immigrant *Hipparion* defines the age of this fauna.

The strong lateral digits of the Siwalik *Hipparion* do not offer any evidence of a separate origin, as advocated by Dr. Pilgrim. Careful studies of the material in the American Museum collection have shown that the lateral digits in the Siwalik *Hipparion* are strong because the entire foot is robust and heavy. Considered from the standpoint of relative proportions, the lateral digits of the Siwalik *Hipparion* are really not any more developed than the lateral digits in the small, slender species of North American *Hipparion*.

But even if this were not the case, even if the lateral digits were actually proportionately larger in the Siwalik *Hipparion* than they are in the North American *Hipparion*, Dr. Pilgrim's argument would not necessarily be substantiated. We know that reversals in evolution are not at all uncommon in the phylogenetic development of various groups of mammals. To argue that reversals in the development of the lateral digits of the Equinae could not have occurred, that there would not have been secondary enlargements of the side toes, is to argue against a phenomenon for which we have abundant evidence. It is giving undue weight to the processes of orthogenesis.

(The details concerning the development of the lateral digits in the Siwalik *Hipparion*, as contrasted with the North American *Hipparion*, are presented in a forthcoming memoir, dealing with the American Museum Siwalik collection.)

As to the argument that the American deposits are so well known that an ancestor of the Pikermi *Hipparion* could "hardly escape notice there," this line of reasoning may be reversed with equal facility. Certainly the European deposits are pretty well known, as are the Asiatic (due to the work of the Swedish and the American expeditions during the past fifteen years), and if an ancestor of *Hipparion* were to be found in them it should have probably turned up by this time. As a matter of fact, there is no equine in the European or the Asiatic Tertiary that is ancestral to *Hipparion*, and since such parental forms are to be found perfectly exemplified in the advanced species of *Merychippus* in North America, it seems only reasonable, at least on the basis of our present knowledge, to suggest that the origin of the genus *Hipparion* was in the New World.

Nor can the Chinji *Hipparion* be a primitive link, as Dr. Pilgrim suggests, because it is fully as advanced in structure as the later Middle Siwalik *Hipparion*.

In the light of these considerations, there seems to be but one course to take, and that has been indicated above.

1.—*Hipparion* is of North American origin, descended from *Merychippus*.

2.—It migrated to Eurasia.

3.—It arrived in Eurasia subsequent to its appearance in the Valentine (basal Pliocene) of North America.

The foregoing arguments have been concerned chiefly with the problem of the Chinji fauna and its age. It has been shown that the Chinji fauna is equivalent to or later than the Valentine fauna of North

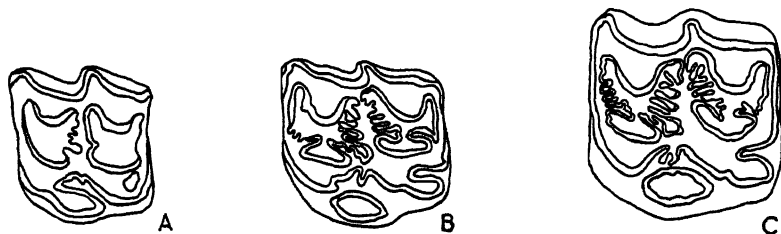


Fig. 3. *Hipparion* molars from North America and India.

A. *Hipparion gratum*, Valentine, Lower Pliocene, North America.

B. *Hipparion mohavense*, Ricardo, Lower Pliocene, North America.

C. *Hipparion theobaldi*, Chinji, Lower Pliocene, India.

A and B from Osborn, 1918. All figures natural size.

This chart illustrates the rapid structural evolution of the *Hipparion* molar during Lower Pliocene times.

America, which would make it either of uppermost Sarmatian or of Pontian age.

Coming now to the typical Middle Siwalik fauna, we find that it is separated by an appreciable time interval (as represented by a considerable thickness of continental sediments) from the Lower Siwalik or Chinji fauna. Therefore the Middle Siwalik fauna must be of post-Upper Sarmatian or post-Pontian age, and the probabilities are in favor of the latter consideration. But, since the Middle Siwalik fauna is homotaxially of Pontian affinities, we must consider the probability of its having persisted on into post-Pontian times with little changes among the forms that constitute it. Thus the Middle Siwalik fauna has followed the same trend of persistence that characterized the Chinji fauna.

THE AGE OF THE UPPER SIWALIKS AS INFERRED BY THE
INTERCONTINENTAL MIGRATION OF *Equus*

Discoveries made during the course of the past ten years prove beyond much doubt that the genus *Equus* is of North American origin. It is to be derived from the genus *Plesippus*, described by Matthew, which in turn is descended from *Pliohippus*. *Hipparion*, often cited by European authorities as a form ancestral to *Equus* is in reality a phylogenetic side line that eventually became extinct without giving rise to any later forms.

Just as a continuous series of gradations connect *Merychippus* and *Hipparion*, so does *Merychippus* evolve into *Pliohippus*. The change from the earlier to the later form in this case is marked by:

- 1.—An increase in size.
- 2.—An increase in the length of the limbs.
- 3.—A reduction of the lateral digits, and a complete suppression of the phalanges on the lateral digits, in most species.
- 4.—An increase in the size and hypsodonty of the cheek teeth.
- 5.—Retention of the simple enamel foldings on the fossette borders of the upper cheek teeth.
- 6.—Retention of a connection between the protocone and the protoloph of the upper cheek teeth.

An evaluation of the above listed structural changes demonstrates a trend in the direction of *Equus*. Points three, five, and six are especially significant. In *Hipparion* the lateral digits are well developed, the enamel of the upper cheek teeth becomes complexly folded and the protocone becomes isolated from the protoloph. These are characters that mark the aberrant position, if we wish to call it that, occupied by *Hipparion* in the phylogenetic scheme of the Equidae. Now in these particulars *Pliohippus* does show a definite trend towards the *Equus* condition and this trend is still further developed in the genus *Plesippus*.

Plesippus is a large horse, as large as the wild species of *Equus*, in which the lateral digits are reduced to mere splints. The skull and teeth are very close to the skull and teeth of *Equus*, but they show certain *Pliohippus* characters. *Plesippus* forms a perfect link between *Pliohippus* and *Equus*.

Therefore it seems well proved that *Equus* had its origin in North America, and that it subsequently migrated to Eurasia.

The first appearance of *Equus* in North American deposits is at the base of the Pleistocene. Following the same line of reasoning that applied to *Hipparion*, it at once becomes evident that the first appear-

ance of *Equus* in Eurasia must be subsequent to its appearance in America. Therefore *Equus* must mark the Pleistocene in the Old World, and the appearance of this genus in the Upper Siwalik deposits denotes the Pleistocene age of these beds.

CONCLUDING REMARKS

Should the evidence of one or two genera, namely *Hipparion* and *Equus*, be given weight over the evidence of entire faunas in deciding questions of correlation? In the case of the Siwalik problem, it should, because the horses in the Siwaliks are the invading elements from North America, while the large portion of the other animals in the several faunas are indigenous in their origin. Dr. Matthew has advocated the importance of invading forms in a fauna; he has shown that new forms suddenly appearing from outside in an assemblage of animals are much safer guides as to the age of the assemblage than are the indigenous members alone. Animals that have evolved in a certain region may persist on past the period of their typical expression, thereby extending the time range of their faunal association and thus introducing doubts as to their true age, but as to the appearance of invading forms there can be little doubt. Invading animals link up a fauna with other definitely known faunas, thereby giving clues to the true correlation of the assemblage. For these reasons the arguments set forth in the foregoing pages are considered as giving the valid evidence regarding the correlation of the Siwalik deposits of India.

ADDITIONAL REMARKS

Since the foregoing remarks were written, a paper by Teilhard and Stirton¹ has appeared, which has some bearing on the problem of the correlation of the Siwaliks. In the above-mentioned paper (correlation table, p. 284) the Lower Siwaliks are indicated as of uppermost Vindobonian age, the Middle Siwaliks are correlated with the Pontian, and the Upper Siwaliks are placed in the Astian, or uppermost Pliocene. This correlation, though in a way somewhat intermediate between Pilgrim's and Matthew's correlations, does tend to favor Pilgrim's views as to the age of the Siwaliks.

On pages 281 and 282 of the above-cited work the following statement appears.

¹Teilhard de Chardin, P., and Stirton, R. A. 1934. 'A Correlation of some Miocene and Pliocene Mammalian Assemblages in North America and Asia with a Discussion of the Mio-Pliocene Boundary.' Univ. of Calif. Publ., Bull. Dept. Geol. Sci., XXIII, No. 8, pp. 277-290.

"The argument has been advanced that, because *Hipparion* is derived from the North American Miocene genus *Merychippus*, hipparions should appear in North America in the Upper Miocene or prior to their appearance in Europe. There is good evidence, however, which indicates that *Neohipparion* and *Nannippus* are derived from different species of *Merychippus*; accordingly, the Old World hipparions are probably descendants of an unknown Asiatic *Merychippus* or a *Merychippus* in this country older than the Niobrara River fauna, which contains advanced species of *Merychippus* showing intergradation with *Neohipparion* and *Pliohippus*. At least, the species of *Merychippus* which show intergradation with the American genera did not give rise to *Hipparion* of the Old World."

The Niobrara River fauna, referred to in the foregoing quotation, is equivalent to the Valentine fauna contained in the Valentine formation, as used by Matthew, Simpson and others.

If the Old World *Hipparion* was independently derived from an Asiatic species of *Merychippus*, the arguments set forth in the earlier pages of this present paper are materially weakened, and Pilgrim's views as to the correlation of the Lower and the Middle Siwaliks are strengthened. On the other hand, there is no real evidence for supposing that the Old World *Hipparion* was derived from an Old World *Merychippus*. In the first place, an Old World *Merychippus* has never been found. Pilgrim speaks of some of the Chinji *Hipparion* as being "slightly smaller and more brachyodont" than the Middle Siwalik *Hipparion*. The material in the American Museum collection indicates, however, that the Chinji *Hipparion* was but little different if at all separate from the Middle Siwalik *Hipparion*. Thus, neither an Old World *Merychippus* nor a primitive Old World *Hipparion* is known from the material extant.

In the second place, it seems rather unnecessary to postulate an Old World *Merychippus* or a primitive Old World *Hipparion* as the ancestors of the typical Old World *Hipparion*, since perfectly good structural ancestors of the proper kind are to be found in North America. *Hipparion gratum*, *Hipparion gratum tehonense* and related species would seem to be adequate as ancestral types for the Old World *Hipparion*. These species have, as do the Old World forms, a round oval protocone, a moderately high molar crown, a rather deep lacrymal fossa, and other features in common. Moreover, the North American form is primitive, as we might expect an ancestral species to be.

In Teilhard and Stirton there is a statement to the effect that the

"species of *Merychippus* which show intergradation with the American genera [of *Hipparion*] did not give rise to *Hipparion* of the Old World." This may be true, but it does not argue against the strong probability that *Hipparion gratum* and its related species are the direct ancestors of the Old World *Hipparion*. Moreover, the primitive characters of *Hipparion gratum* as contrasted with the advanced and specialized characters of all of the Old World members of the genus, even the earliest forms, show that a certain time element was involved in the migration of the genus from North America to Eurasia.

Since there is no definite proof for the separate origin of the Old World *Hipparion* in Eurasia, it seems reasonable to look for their ancestors in North America, typified by such species as *Hipparion gratum*. Since even the earliest of the Eurasiatic *Hipparion* are relatively advanced and specialized species, it is reasonable to think that a certain amount of geologic time passed between the appearance of the genus in North America and its migration to Asia and Europe. Therefore the correlation of the Siwaliks as advocated by Matthew and as reviewed in the preceding pages of this paper would seem to be justified on the basis of all of the available evidence now known.

In the paper by Teilhard and Stirton the Valentine formation of northwestern Nebraska is divided. The lower phases supposedly transitional between the Miocene and the Pliocene are named the Niobrara River, whereas the upper portion, said to be transitional between the Lower and the Middle Pliocene, retains the name Valentine. The name Valentine is well established in the literature to indicate the formation and the time transitional between the Miocene and the Pliocene, and the abandonment of this usage of the term will lead to some confusion. Lacking more detailed and conclusive evidence on the question of the proposed division, the name Valentine, indicative of the transition from the Miocene to the Pliocene, is retained in the foregoing pages in its original meaning.

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DISTRIBUTIONAL AND PHYLOGENETIC STUDIES ON INDIAN FOSSIL MAMMALS. III

A CLASSIFICATION OF THE CHALICOTHERIOIDEA

BY EDWIN H. COLBERT

INTRODUCTION

The chalicotheres are aberrant perissodactyls having teeth like the teeth of the titanotheres, but having, in the advanced forms at least, clawed feet. Because of this anomalous association of grazing teeth with digging feet, rather than with cursorial feet, the chalicotheres have been of great interest to students of mammalian morphology and taxonomy for many years. Naturally, from the time of the first discovery of chalicotherine remains, the taxonomic position of these curious mammals has been a subject of considerable controversy among palaeontologists and zoologists.

For many years the students of fossil vertebrates did not realize that the chalicotherine skulls and feet, discovered in European and Asiatic deposits, were representative of one kind of animal. Consequently the skulls or teeth were described separately from the feet, and they were variously classified. The feet were almost always identified as belonging to some giant edentates.

Even after Filhol's recognition of the fact that the feet and the skulls, so long regarded as belonging to different animals, in reality were from one animal, there were differences of opinion as to the relationships of the chalicotheres to each other and to other perissodactyls.

Naturally, these divergences of opinion led to the formulation of several systems of classification for the chalicotheres. It is hardly necessary to attempt here a detailed review of the history of research on the Chalicotherioidea, since Holland and Peterson in their Memoir of 1914 give a fairly complete account of the work of various authors from the time of Cuvier on. There will be, however, a presentation of several of the outstanding classifications of the chalicotheres in this paper, and these will be compared to the system of classification now under consideration.

The classification to be set forth below has been briefly outlined in a recent paper, but the bases on which it was founded have not heretofore

been discussed.¹ The detailed discussion of the classification advocated in the following pages, and the evidence in favor of it, is the purpose of the information contained in this paper.

DESIRABILITY OF A SEPARATE SUPERFAMILY CHALICOTHERIOIDEA

Until Filhol made the important discovery that *Macrotherium* is a true perissodactyl with aberrant feet, there had been a variety of views expressed as to the relationships of the chalicotheres. Of course it was recognized by the early students of the group that these animals, as known from the skulls and teeth, should be classified with the ungulates. (As pointed out above, the feet were not associated with the skulls or teeth, and were supposed to be representative of giant edentates.) Huxley, in 1870, placed *Homalodotherium* from South America with *Chalicotherium* as an "anoplotheroid." In 1872 Gill regarded the chalicotheres as members of the Artiodactyla, while in 1873 Gaudry placed them among the Pachydermata. Marsh, in 1874, pointed out the resemblances between the chalicotheres and the titanotheres, and in this regard he came nearer to a true realization of their relationships than did the authors that preceded him. In 1881 Cope placed the chalicotheres near the Tapiridae and the Menodontidae, in the Perissodactyla, and in 1887, after Filhol had announced the association of the skull of *Chalicotherium* with the feet of *Macrotherium*, this same author proposed the erection of a new order, the Ancylopoda, for the reception of the chalicotheres.

The separation of the chalicotheres into a distinct order was accepted with reservations by Osborn in 1893. Finally in 1898, Osborn proposed the division of the Perissodactyla into five superfamilies, and one of these was named the Chalicotheroidea. Subsequent authors have, for the most part, considered the chalicotheres as constituting a separate group of equal rank with the other perissodactyl groups.

Recently, in 1931, Simpson has reduced the chalicotheres to family status and placed them in the superfamily Brontotherioidea.² This opinion, it seems to me, is not justified, and the evidence bearing on it will be presented in the following paragraphs.

If we begin by comparing the most primitive chalicotheres with the most primitive titanotheres we find that the resemblances between them are indeed striking. This is due to the fact that they are primitive, and all primitive perissodactyls are very much like each other—as was especially stressed by Dr. W. D. Matthew many times over.

¹Colbert, E. H. 1934. Bull. Amer. Mus. Nat. Hist., LXVII, pp. 353-355.

²Simpson, G. G. 1931. Bull. Amer. Mus. Nat. Hist., LIX, p. 282.

Naturally *Eomoropus*, the most primitive chalicothere, is very much like *Lambdotherium* and *Eotitanops*, the earliest titanotheres, and in turn it is like *Eohippus*, the earliest horse. All of these genera are characterized by their relatively small size, low primitive skulls, brachyodont teeth and their undifferentiated feet. These are characters that show their common origin; they are characters to be expected in any primitive perissodactyl.

A comparison between the more advanced forms of the chalicotheres and the titanotheres will show how these two groups separated from each other during the course of their phylogenetic development, each following a different kind of anatomical development. In the chalicotheres the skull became rather horse-like, the neck was elongated, the legs became long, the front legs being longer than the hind legs, and the feet remained short and developed claws. On the other hand the titanotheres showed a trend toward the growth of excrescences on the skull (although this did not occur in all of the genera), the body tended to get heavy and the limbs were heavy. The feet had hoofs and were quite different from the feet of the chalicotheres. In both groups the teeth remained very similar to each other. In both groups there was a various reduction in the incisors. The chief differences in the cheek teeth are that in the chalicotheres the hypocone is attached to the metaloph, whereas in the titanotheres the hypocone is always quite separate.

In spite of the similarities of the teeth in the chalicotheres and the titanotheres, the differences in the skull, skeleton, and feet seem too profound to warrant a grouping of these forms in a single superfamily.

A COMPARISON OF CLASSIFICATIONS

There have been several attempts at a classification of the chalicotheres, the most outstanding of which have been those of Holland and Peterson (1914), von Zittel as revised by Smith Woodward (1925), Matthew (1929), and von Koeningswald (1932).

Holland and Peterson (1914), in their monograph entitled "Osteology of the Chalicotheroidea," presented the following arrangement for the chalicotheres.

Order UNGULATA

Suborder PERISSODACTYLA

Superfamily Chalicotheroidea

Family Chalicotheriidae

Subfamily Schizotheriinae

Genera *Schizotherium*

Pernatherium
Eomoropus
Phylotillon
 Subfamily Moropodinae
 Genera *Moropus*
 Nestoritherium
 Subfamily Macrotheriinae
 Genera *Macrotherium*
 Chalicotherium
 Circotherium

In the earlier editions of von Zittel's 'Text Book of Palaeontology' no attempts were made to subdivide the chalicotheres; the genera were listed under one heading. In Smith Woodward's revision of 1925, however, the following arrangement of the group was presented.

Order UNGULATA
 Suborder PERISSODACTYLA
 Family Chalicotheriidae
 Subfamily Schizotheriinae
 Genera *Schizotherium*
 Pernatherium
 Eomoropus
 Phylotillon
 Subfamily Moropodinae
 Genera *Moropus*
 Nestoritherium
 Subfamily Macrotheriinae
 Genera *Macrotherium*
 Chalicotherium
 Circotherium

Obviously this classification has been adapted, without change, from the work of Holland and Peterson. The only difference to be noted is in the fact that no superfamily designation is used.

In 1929 Dr. W. D. Matthew classified this group along somewhat different lines. His arrangement is presented below.

Family Chalicotheriidae
 Subfamily Eomoropinae
 Genera *Eomoropus*
 Subfamily Chalicotheriinae
 A.—Brachyodont Series

Genera? *Olsenia*

? *Pernatherium*

Schizotherium

Macrotherium

Chalicotherium

Circotherium

B.—Hypsodont Series

Genera *Schizotherium* (tentative for certain species)

Moropus

Phylotillon

Nestoritherium

This classification designed by Matthew is a great improvement over the previous classifications, for it not only is a better expression of the interrelationships of the various genera of chalicotheres, but it is also distinctive in that it embodies certain concepts of taxonomic and phylogenetic significance that had not been realized by other authors.

Dr. Matthew pointed out a fact that other authors had seemingly missed, namely that *Eomoropus* differs far more from the later Tertiary chalicotheres than they do from each other. Consequently he divided the family Chalicotheriidae into two subfamilies, one containing *Eomoropus*, and the other containing all of the later Tertiary genera. This second subfamily, the Chalicotheriinae, he again split, into two series, A and B, based on the brachyodonty and the hypsodonty of the teeth respectively. In making this division of the Chalicotheriinae it may be possible that Matthew fell into one error by placing the genus *Schizotherium* in the same group with *Macrotherium* and *Chalicotherium* (series A of his classification). It would seem that *Schizotherium* is more truly referred to the second series, along with *Moropus*, *Phylotillon*, and *Ancylotherium*. Evidence in favor of this statement will be brought out below.

Of course, Matthew had especially in mind *Schizotherium pilgrimi*, a form of Lower Miocene age in which the molars are brachyodont and quadrate as in *Macrotherium*. This species would certainly fall into Matthew's series A. A close examination of the figure of *S. pilgrimi* would seem to show, however, that this form may not belong to the above-mentioned genus, but that it may rather be a primitive chalicotherine directly ancestral to *Macrotherium*. The questionable relationship of *Schizotherium pilgrimi* was recognized by Forster Cooper and by Matthew.¹

¹Matthew, W. D. 1929. Bull. Amer. Mus. Nat. Hist., LVI, p. 518.

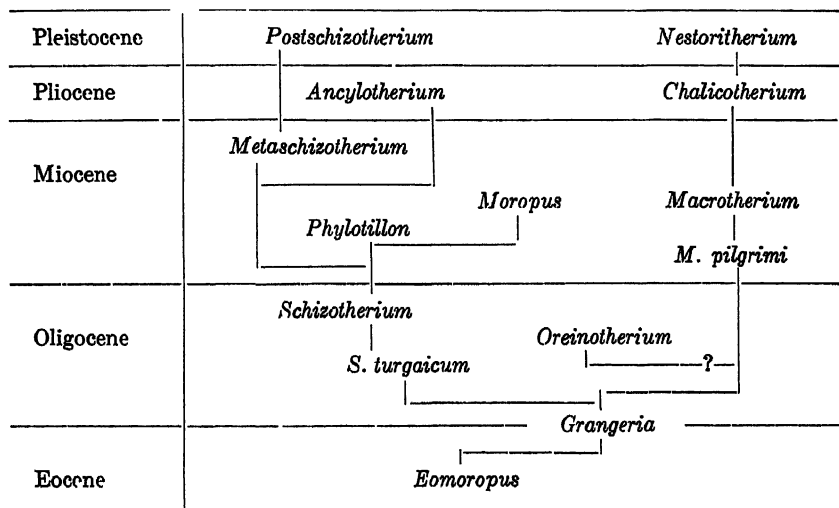
"*Schizotherium pilgrimi* [is] certainly not the milk dentition of *Phyllotilon*, and has every appearance of being permanent dentition of a brachyodont chalicothere of quite small size and very primitive construction of the teeth, the anterior transverse crest being more normally developed and protocone less isolated and less shifted in position than in any Miocene genus. I suspect that Cooper's identification indicates that *Schizotherium* belongs, some species at least, in the chalicotherine series as defined below, as the earliest stage of its development."

Dr. Matthew's statement, quoted above, bears directly on the question of the relationships of *Schizotherium turgaicum* Borissiak, an Oligocene form from eastern Asia. This species was originally described as belonging to the genus *Schizotherium*, but Koenigswald in 1932 referred it to *Macrotherium*, especially on the basis of its quadrate, brachyodont upper molars.

A close scrutiny of the figures of *S. turgaicum* leads to the conclusion that this form is not a *Macrotherium*, as was supposed by Koenigswald, but rather is a much more primitive genus, possibly more primitive even than *Schizotherium*. *S. turgaicum* shows certain characters that relate it to the Eocene chalicotheres, *Eomoropus* and *Grangeria*. The quadrate upper molar may be a primitive character inherited from an Eocene ancestor such as *Eomoropus*. In the lower molars the metastylid is distinct, being rather separated from the anterior spur from the hypoconid—a primitive character found in most of the early Eocene perissodactyls. In the hind foot of *S. turgaicum* the astragalus is narrow, and its trochlea is relatively deep, as in the primitive Eocene perissodactyls. On the other hand, the neck of the astragalus is reduced, an advanced character, and its lower articular surface has a facet for the navicular only. In this last feature *S. turgaicum* shows a decided trend toward the *Moropus* type of astragalus. The metapodials of *S. turgaicum* are long, and in general they show a definite trend toward the long foot characteristic of *Moropus* and related genera. The phalanges are rather primitive.

Thus we see that *Schizotherium turgaicum* is a primitive Oligocene chalicothere, showing many primitive heritage characters retained from its Eocene ancestors, but developing certain habitus characters that show a definite trend toward the typical Oligocene *Schizotherium* of Europe and Asia. If *S. turgaicum* is of the genus *Schizotherium*, then we must suppose that the genus shows two broad stages of development, an earlier one retaining many holdovers of Eocene heritage characters, and a later one in which the primitive characters are for the most part lost, and the definitive *Schizotherium* habitus characters are established.

It may be that *Schizotherium turgaicum* is a form close to the stem of the schizotherine branch of chalicotheres, just as *Grangeria gobiensis*, recently described, is a primitive chalicotherine approaching the beginnings of the chalicotherine branch. This conclusion is suggested by a study of the astragalus in these forms, and although single characters are never to be taken as the absolute evidence for phylogenetic relationships, still in the case under consideration these single characters carry a considerable degree of weight. *S. turgaicum* has no cuboid facet on the astragalus, which makes it like *Moropus* and other schizotherine chalicotheres; *Grangeria* has a very small cuboid facet on the astragalus, and this foreshadows the condition typical of *Chalicotherium* and related genera. On the other hand, the teeth of *S. turgaicum* are much more primitive than the teeth of the typical *Schizotherium*, so we have good reason to think that this eastern Asiatic form is less advanced in its phylogenetic development than are the characteristic Oligocene species of *Schizotherium*. The above suggested relationships may be represented in the following manner.



Turning now to the classification formulated by von Koenigswald in 1932, we see that the genus *Schizotherium* is grouped with *Moropus*, *Phylotillon*, etc., which would seem to be the correct expression of its relationships.

Family Chalicotheriidae

Subfamily Eomoropinae

Genus *Eomoropus*

Subfamily Chalicotheriinae

Genera *Chalicotherium*

[Including

*Macrotherium**Schizotherium turgaicum**Schizotherium pilgrimi*]*Nestoritherium*

[Including

Circotherium]

Subfamily Schizotheriinae

Genera *Schizotherium**Metaschizotherium**Colodus* [Referring to *Ancylotherium*
pentelici]*Phylotillon**Moropus**Postschizotherium*

In his original classification, von Koenigswald listed the various species under the several genera.

This classification, evidently based on Matthew's classification of 1929, contains certain inconsistencies. The genus *Grangeria*, named by Zdansky in 1930, is omitted. The genus *Macrotherium* is suppressed, and its species are considered as belonging to the genus *Chalicotherium*, a change the validity of which may be doubted. The name *Colodus* is revived for *Ancylotherium pentelici* (*Nestoritherium pentilici*), notwithstanding the fact that *Colodus* is properly referable to *Atelodus pachygnathus*. Then again, von Koenigswald made his two subfamilies Chalicotheriinae and Schizotheriinae equal in rank to his subfamily Eomoropinae, in spite of the fact that Matthew had pointed out the necessity of regarding them as of lesser value than the Eomoropinae. In this regard, von Koenigswald overlooked the important fact that the two subdivisions of advanced chalicotheres are much more like each other than they are like the primitive subfamily, Eomoropinae, which would of course call for a recognition of them as lesser divisions in the classification of the chalicotheres.

A CLASSIFICATION OF THE CHALICOTHERIOIDEA

With the foregoing considerations in mind we may now turn to the question of the classification being proposed in the present paper. A few preliminary remarks may be in order at this point.

The earliest known chalicotheres are of Middle to Upper Eocene age, and are found in North America and in Asia. As indicated above, Dr. Matthew pointed out the fact that these primitive chalicotheres are in reality more nearly like the Eocene titanotheres and the other primitive perissodactyls than they are like the later chalicotheres. These Eocene forms are characterized by unspecialized skulls and feet, and a primitive perissodactyl dentition with the canines well developed.

As the chalicotheres continued into the Oligocene and into the later Tertiary, they would seem to have split into two well-defined groups. One group, typified by *Schizotherium* and *Moropus*, is characterized by a rather elongated skull, elongated, hypsodont cheek teeth, a skeleton in which the fore and the hind limbs are of subequal length, and feet having long metapodials. The other group typified by *Macrotherium* and *Chalicotherium*, is characterized by a skull in which the facial portion is short, the cheek teeth are quadrate and brachyodont, a skeleton in which the fore limbs are longer than the hind limbs, and feet having short metapodials and flattened phalanges.

This twofold division of the advanced chalicotheres would seem to be a natural one, for when it is tested in the light of our present available knowledge it would seem to hold true. Therefore, on the basis of the division of the chalicotheres into a primitive group and two advanced groups the following classification is presented. It is really a slight modification of Matthew's classification of 1929.

Order PERISSODACTYLA

Superfamily Chalicotherioidea

Family Chalicotheriidae

Subfamily Eomoropinae

Genera *Eomoropus**Grangeria*

Subfamily Chalicotheriinae

Tribe Chalicotherini

Genera *Chalicotherium**Macrotherium**Nestoritherium**Oreinootherium*

Tribe Schizotherini

Genera *Schizotherium**Metaschizotherium**Moropus**Phylotillon**Ancylotherium**Postschizotherium*

Incertae Sedis

Pernatherium

A more detailed presentation of this classification is now offered.

Order PERISSODACTYLA

Superfamily Chalicotherioidea

Family Chalicotheriidae

Cheek teeth bunoselenodont; last upper premolars with two outer and one inner cusp, last lower premolars with double crescents; upper molars with W-shaped ectoloph, with protoloph connecting protocone and paracone, and metaloph connecting metacone and hypocone; lower molars doubly crescentic with a separate metastylid, and the third lower molar without a talonid except in the primitive genera. Auditory bulla large; orbit open behind; strong postglenoid and paroccipital processes; foramen lacerum anterius and foramen rotundum enclosed in a common vestibule; alisphenoid canal present; mandible with a broad ascending ramus. Cervical vertebrae keeled. Pelvis elongated; femur with or without third trochanter. Distal face of the astragalus articulating with the navicular and cuboid or with the navicular only. Manus either tetradactyl or tridactyl; pes tridactyl; distal ends of metapodials with convex articulating surfaces; terminal phalanges deeply bifid, except (?) in the primitive genera.

Subfamily **Eomoropinae**

Primitive and of small size. Quadrate, brachydont molars, with protoloph connecting protocone and metacone, and metaloph connecting paracone and hypocone; lower molars with a separate metastylid; third lower molar with a talonid. First upper premolar and both upper and lower canines present; lower canine more or less in series with the incisors; incisor formula variable. Manus tetradactyl; pes tridactyl; astragalus with or without a cuboid facet (in *Grangeria* and *Eomoropus* respectively). Metapodials and phalanges not highly modified as in the later chalicotheres. Limbs subequal in length.

EOMOROPUS Osborn, 1913

Eomoropus amarorum (Cope)—Generic type. Washakie formation, Upper Eocene, Wyoming.

Eomoropus annectens Peterson. Uinta formation, Upper Eocene, Utah.

Eomoropus quadridentatus Zdansky. Ludian, Upper Eocene, Honan, China.

Eomoropus major Zdansky. Ludian, Upper Eocene, Honan, China.

Eomoropus minimus Zdansky. Ludian, Upper Eocene, Honan, China.

GRANGERIA Zdansky, 1930

Grangeria canina Zdansky—Generic type. Lower Oligocene (?), Shantung, China.

Grangeria gobiensis Colbert. Irdon Manha formation, Upper Eocene, Inner Mongolia.

Subfamily **Chalicotheriinae**

Advanced genera of large size. Premaxillaries often, if not always edentulous. Canines and first upper premolar absent; upper molars quadrate to elongate; no third lobe on the last lower molar. Manus and pes highly modified; femur with third trochanter.

Tribe **Chalicotherini**

Advanced genera of medium to very large size. Quadrate, brachyodont upper molars, with ectoloph bent lingually beyond the median line of the tooth; molar indices usually above 90; metastylid reduced in lower molars. Manus and pes tridactyl, manus longer than pes; trapezium wanting; astragalus with a cuboid facet; articulating faces of the proximal phalanges tending to be parallel with the long axis of the bone; claws short; limbs unequal, the forelegs being much longer than the hind legs.

CHALICOTHERIUM Kaup, 1833

Chalicotherium goldfussi (Kaup)—Generic type. Pontian, Lower Pliocene, Eppelsheim, Germany.

Chalicotherium antiquum (Kaup). Pontian, Lower Pliocene, Eppelsheim, Germany.

NESTORITHERIUM Kaup, 1859

Nestoritherium sivalense (Falconer and Cautley)—Generic type. Upper Siwaliks, Lower Pleistocene, India.

?*Nestoritherium sindiense* (Lydekker). Manchar beds, Mio-Pliocene, Sind.

Nestoritherium sinense (Owen). Lower Pleistocene, Wanhhsien, China.

MACROTHERIUM Lartet, 1837

Macrotherium sansaniense Lartet—Generic type. Sarmatian, Upper Miocene, Sansan, France.

Macrotherium grande Lartet. Sarmatian, Upper Miocene, Sansan, France.

Macrotherium magnum Lartet. Sarmatian, Upper Miocene, Sansan, France.

Macrotherium giganteum Gervais. Sarmatian, Upper Miocene, Sansan, France.

Macrotherium secundarium Filhol. Sarmatian, Upper Miocene, Sansan, France.

Macrotherium minus Lartet. Sarmatian, Upper Miocene, Sansan, France. [The foregoing species are probably synonymous.]

Macrotherium rhodanicum Deperet. Upper Miocene, La Grive St. Alban, France.

Macrotherium salinum Forster Cooper. Chinji zone, Lower Siwaliks, Lower Pliocene, India.

Macrotherium pilgrimi (Forster Cooper). Bugti beds, Lower Miocene, Baluchistan.

Macrotherium turgaicum (Borissiak). Oligocene, Siberia.

Macrotherium brevirostris Colbert. Tung Gur formation, Upper Miocene, Inner Mongolia.

Macrotherium matthewi (Holland and Peterson). Pawnee Creek formation, Middle Miocene, Colorado.

OREINOTHERIUM Russell, 1934

Oreinothierium bilobatum (Cope)—Generic type. Cypress Hills beds, Lower Oligocene, Saskatchewan.

Tribe Schizotheriini

Advanced genera of medium to very large size. Elongated, hypsodont molars, with ectoloph tending to be vertical, thus making the tips of the paracone and metacone on or outside of the median line of the tooth; molar indices usually below 90; metastylid not reduced. Manus tetradactyl, pes tridactyl; trapezium present; astragalus articulating with navicular only; articulating facets of proximal phalanges inclined to median axis of bones; limbs subequal in length.

SCHIZOTHERIUM Gervais, 1876

Schizotherium priscum (Gaudry)—Generic type. Phosphorites, Oligocene, France.

Schizotherium modicum (Gaudry).—Phosphorites, Oligocene, France.

Schizotherium ingens (Filhol). Phosphorites, Oligocene, France.

Schizotherium wetzleri (Kowalevsky). Aquitanian, Oligocene, France.

Schizotherium avitum Matthew and Granger. Ardyn Obo formation, Oligocene, Mongolia.

METASCHIZOTHEIUM von Koenigswald, 1932

Metaschizotherium fraasi von Koenigswald—Generic type. Upper Miocene, Germany and France.

Metaschizotherium bavaricum von Koenigswald. Upper Miocene, Germany.

POSTSCHIZOTHERIUM von Koenigswald, 1932

Postschizotherium chardini von Koenigswald—Generic type. Pleistocene, Nihowan, China.

PHYLOTILLON Pilgrim, 1910

Phylotillon naricus (Pilgrim)—Generic type. Bugti Beds, Lower Miocene, Baluchistan.

MOROPUS Marsh, 1877

Moropus distans Marsh—Generic type. Harrison formation, Lower Miocene, Nebraska.

Moropus elatus Marsh. Harrison formation, Lower Miocene, Nebraska.

Moropus senex Marsh. Harrison formation, Lower Miocene, Nebraska.

Moropus cooki Barbour. Harrison formation, Lower Miocene, Nebraska.

Moropus maximus Holland and Peterson. Harrison formation, Lower Miocene, Nebraska.

Moropus hollandi Peterson. Harrison formation, Lower Miocene, Nebraska.

Moropus petersoni Holland. Harrison formation, Lower Miocene, Nebraska.

Moropus parvus Barbour. Harrison formation, Lower Miocene, Nebraska.

[The foregoing species probably, for the most part, are synonymous.]

Moropus merriami Holland and Peterson. Virgin Valley formation, Middle Miocene, Nevada.

Moropus oregonensis (Leidy). Bridge Creek beds, Miocene, Oregon.

ANCYLOTHERIUM Gaudry, 1863

Ancylotherium pentelici (Gaudry and Lartet)—Generic type. Pontian, Lower Pliocene, Pikermi, Greece and Samos Island.

Of Uncertain Position

Pernatherium rugosum Gervais. Eocene, France.

THE EVOLUTION OF THE CHALICOTHERES

The chalicotheres would seem to have had their beginnings as small, unspecialized perissodactyls in North America. *Eomoropus amarorum* from the Eocene of Wyoming, a genus very close to the primitive titanothere, is our first record of a definitely ancestral chalicothere. During the closing stages of the Eocene period the descendants of *Eomoropus* migrated from North America to Asia, probably by way of a trans-Bering land bridge, and in the oriental continent they spread over a broad area, enjoying a long period of untrammelled development. These primitive chalicotheres persisted through the uppermost stages of the Eocene in Asia and held over into the lower stages of the Oligocene, and they may be regarded as rather directly descended from *Eomoropus* of North America. They are represented by two genera, namely *Eomoropus* and *Grangeria*.

From these generalized Eocene chalicotheres two specialized phylogenetic branches arose and developed through the middle and upper portions of the Tertiary epoch. One of these groups, the Chalicotherini, typified by quadrate, brachyodont upper cheek teeth and short feet, was mainly Eurasiatic in its distribution. It enjoyed a long period of phylogenetic evolution through the Miocene and the Pliocene and into the Pleistocene, and it spread throughout Europe and Asia. It would seem, also, that in the Miocene certain members of this group (*Macrotherium*) crossed from Asia to North America.

The other group, the Schizotherini, typified by hypsodont, elongated cheek teeth and long feet, inhabited both Eurasia and North America. In the Oligocene the members of this group are well defined in Eurasia, but whether they were present in North America or not, is a question difficult to decide at this time. Chalicothere remains in the Oligocene of North America are extremely rare, to say the least. In the Miocene, however, we find members of this group in the Old World (*Phylotillon*) and in the New World (*Moropus*). This line persisted through the Lower Pleistocene in Europe and Asia.

Did the chalicotheres originate in North America, migrate to Asia, and then become extinct in America, only to reappear in a subsequent counter-migration from Asia. Our present knowledge of the distribution of the group would lend some weight to this idea. For instance, *Eomoropus* appears in the Eocene in North America, and slightly later in the Upper Eocene or Lower Oligocene of Mongolia and China. Then through the Oligocene we have no very conclusive records of chalicotheres in North America, although their remains are relatively common in Europe and Asia. Finally the two branches of advanced chalicotheres are found in North America, where they persist for but a short time. In Eurasia, however, these two branches of advanced chalicotheres undergo a considerable degree of adaptive radiation, and persist until and through the early Pleistocene.

Cope described "*Chalicotherium* ' *bilobatum* from the Oligocene of Saskatchewan, on the basis of a very fragmentary specimen. Russell has recently made this species the type of a new genus, *Oreinotherium*. Unfortunately the status of this form is still a matter of some doubt.

Perhaps there was a series of migrations and counter migrations between North America and Asia. Perhaps the Old World was the center of adaptive radiation for the advanced chalicotheres, whereas the New World offered a haven for certain immigrant and restricted forms.

Of course these suppositions are little more than tentative specula-

tions. It must be admitted that the lack of chalicotheres in the Oligocene of North America is purely circumstantial, dependent on the chances of discovery and consequently is not a real index as to the presence or the absence of the group in the New World. If some really well-preserved remains of the Schizotherini were to be found in the Oligocene of North America, we would be justified in regarding *Moropus* as a truly autochthonous type, but until such a discovery is made, the possibility of *Moropus* being an immigrant form, descended from *Schizotherium* of Eurasia, remains strong. At any rate, from the above considerations, we may conclude that the chalicotheres form a group of North American origin, but primarily of Eurasiatic radiation.

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DISTRIBUTIONAL AND PHYLOGENETIC STUDIES ON INDIAN FOSSIL MAMMALS. IV

THE PHYLOGENY OF THE INDIAN SUIDAE AND THE ORIGIN OF THE HIPPOPOTAMIDAE

BY EDWIN H. COLBERT

THE PHYLOGENY OF THE INDIAN SUIDAE

During the middle and later portions of the Tertiary period, India was a great center for the adaptive radiation of the Suidae. The fossil remains of pigs are numerous in the Siwalik deposits of the northern Punjab, and they represent a variety of types indicative of the phylogenetic plasticity of the suid group. Here, in one locality, in a series of deposits ranging in age from Upper Miocene to Lower Pleistocene, may be found almost the complete phylogenetic history of the Suidae, from the most primitive, undifferentiated types to the very advanced, highly specialized genera. The following remarks will constitute a brief review of the Indian fossil Suidae, as found in the Siwalik Series, with especial emphasis on their relation to the general phylogenetic history of the group.

PREVIOUS STUDIES ON SIWALIK SUIDAE

Of course the first serious student of fossil pigs from the Siwalik beds was Hugh Falconer, the founder of Vertebrate Palaeontology in India. In the 'Fauna Antiqua Sivalensis,' part 8, published in 1847, several genera and species of Suidae were named and illustrated. Falconer did not, however, contribute anything in the manner of a survey or a systematic study of the Indian fossil Suidae that he had named.

In 1884, Richard Lydekker published his 'Siwalik and Narbada Bunodont Suina' in the 'Palaeontologica Indica.' This was a detailed monograph on all of the Indian fossil pigs known at the time, and although Lydekker did not discuss the phylogeny of the Suidae, he did consider, in his descriptions of the various species of Siwalik suids, the probable relationships of these forms to each other and to other pigs.

In 1899, Hans Stehlin published 'Geschichte des Suiden Gebisses,' a lengthy monograph on the evolution and structure of the teeth in the

Suidae. In this work were included descriptions of the teeth of the various genera and species of Siwalik pigs.

Dr. Guy E. Pilgrim brought out, in 1926, his monograph entitled 'The Fossil Suidae of India.' This was a complete review of the species known to Lydekker, and in addition Pilgrim described several new genera and a number of new species on the basis of specimens discovered by himself in the Punjab. Pilgrim's explorations in the Kamlial and Chinji horizons of the Lower Siwaliks, faunal zones unknown to Lydekker, greatly augmented the number of species and genera of suids from the Siwaliks. In this monograph, Pilgrim presented a large chart that diagrammed the phylogenetic classification of the Suidae.

Pilgrim's phylogenetic diagram for the Suidae is noteworthy because of the detail in which it is carried out, based as it is on his important and careful studies of the Siwalik pigs in the London and the Calcutta museums. It would seem to me, however, that this phylogeny as presented by Pilgrim, is unduly complex, due to the fact that he has placed great weight on rather small differences of dental structure in his formulation of a classification for the group under consideration. In making this criticism I follow the lead of Dr. Matthew, who expressed a similar opinion in 1929, in the following manner.

"Doctor Pilgrim has recently monographed the Indian Suidae, but his methods appear to me to place too much weight upon one or two unsupported differentiation characters, allowing not enough for individual variation, and resulting in an extraordinarily complex arrangement which would be far more complex if the same methods were applied to *all* the Old and New World suillines, instead of only to the Indian groups."¹

In the following pages there will be presented brief discussions of the several genera of Siwalik Suidae. Species will be considered incidentally, where they may come into the discussion. Finally, a phylogeny for the Siwalik pigs will be outlined, which may be compared directly with Pilgrim's phylogeny of 1926.

A DISCUSSION OF THE INDIAN SUIDAE

In the discussion to be offered below the Suidae are considered as divisible into several phylogenetic groups or branches. Each of these groups is supposed to be a phylogenetic unit, and as such each is discussed. The Siwalik Suidae have been divided in the following manner.

¹Matthew, W. D. 1929. Bull. Amer. Mus. Nat. Hist., LVI, p. 456.

- GROUP I—*Palaeochoerus*
 GROUP II—*Listriodon*
 GROUP III—*Conohyus*—*Sivachoerus*—*Tetraconodon*
 GROUP IV—*Dicoryphochoerus*—*Sus*—[*Phacochoerus*]
 Propotamochoerus—*Potamochoerus*
 Hyosus—*Sivahus*—*Hippohyus*
 GROUP V—*Lophochoerus*
 GROUP VI—*Sanitherium*

GROUP I

PALAEOCHOERUS

Although the remains of *Palaeochoerus* are not common in the Siwalik Series, still they are present to a degree sufficient to establish the genus as having lived through Lower and Middle Siwalik times. Here is an example of the persistence of a primitive, ancestral form to a period much later than its typical time of phylogenetic development, so that it exists side by side with its specialized descendants.

Palaeochoerus may be considered as close to the stem form for all of the Suidae, and it first appears in the Oligocene of Eurasia. It is structurally primitive, being of small size, with an unspecialized type of skull and with bunodont, simple cheek teeth. From *Palaeochoerus* the later Tertiary pigs developed along several lines of adaptive radiation, characterized by a considerable diversity of skull form and of tooth structure.

The species of *Palaeochoerus* in the Siwalik Series are quite similar to the typical *Palaeochoerus* of the Eurasiatic Oligocene, so we are justified in the conclusion that the genus persisted on from the Oligocene into the Middle Pliocene in India, without undergoing any appreciable evolutionary changes. Thus *Palaeochoerus* in India is a primitive suid, structurally ancestral to the advanced genera with which it is contemporaneous.

GROUP II

LISTRIODON

The genus *Listriodon* is very abundant through the Lower Siwaliks, and it persists on into the lower portions of the Middle Siwaliks. This form must have split off at an early date from the primitive *Palaeochoerus* type of ancestor, for it is specialized in an aberrant manner, quite separated from the more normal kinds of pigs.

Listriodon pentapotamiae the most common species of the genus in India, is closely related to *Listriodon splendens* of Europe and to *Listriogon mongoliensis* of Asia. It is characterized by its very lophodont molar teeth, which in structure closely resemble the teeth of a tapir, by

its heavy upper canines and its laterally directed lower canines. The genus *Listriodon* is also characterized by its rather long, low skull, in which the orbit is set back behind the third molar making the preorbital portion extraordinarily long for a suid of such a geologically early development.

In the Kamlial zone of the Lower Siwaliks there is a primitive, bunodont *Listriodon* which gives us a clue as to how the transition from the more normal suid to the listriodont type took place. This form is the species, *L. guptai*. It is characterized by its small size and its bunodont molars, in which the cross crests, so typical of the more advanced listriodonts, are as yet imperfectly developed.

GROUP III

CONOHYUS-SIVACHOERUS-TETRACONODON

The genus *Conohyus*, a suid of relatively primitive form, is closely related to the genus *Hyotherium*, found in Europe. *Hyotherium* is obviously a fairly direct descendant from *Palaeochoerus*, showing advances over the primitive Oligocene genus, mainly in its larger size, its somewhat more elongated skull, and its slightly more advanced molar teeth. Now *Conohyus* is quite similar to *Hyotherium* in a majority of its features, but it is distinctive especially by reason of its greatly enlarged third and fourth premolars. There are also certain skull characters of *Conohyus* that set it apart, as has been set forth in a recent paper descriptive of the first known skull from the Siwalik Series.¹ Features of special interest are the deeply expanded zygomatic arch, which projects below the occlusal line of the cheek teeth, and the rather elongated preorbital portion. In this discussion, however, we are particularly interested in the evolution of the cheek teeth.

Conohyus is a Lower and Middle Siwalik genus. In the Middle and Upper Siwaliks are two genera that are undoubtedly derived from *Conohyus*. These are *Sivachoerus* and *Tetraconodon*, suids of gigantic size in which the last two premolars are greatly enlarged. *Sivachoerus* is the more generalized of the two, for the development of this form from *Conohyus* has been accomplished mainly by an increase in size and by a certain amount of complication of the cheek teeth. The last two premolars are large, but proportionately they are not very much different from the same teeth in *Conohyus*. *Tetraconodon*, on the other hand, is marked not only by its great actual increase in size over the ancestral type, but also by a very great *proportional* increase in the last two pre-

¹Colbert, E. H. 1933. Amer. Mus. Novitates, No. 621.

molars, so that they have become really gigantic as compared to the premolars ahead of them and the molars behind them. The increase in size, both actually and proportionally, in *Tetraconodon*, has been accompanied by the development of a heavily rugose surface on these teeth.

We see that the evolution of *Sivachoerus* and *Tetraconodon* from *Conohyus* has followed the same general trend in both of the advanced genera, but that the development of *Tetraconodon* has been much more rapid and has advanced to more specialized ends than is the case with *Sivachoerus*. Therefore we may imagine these two genera as the terminal members of a dichotomous branching from the ancestral *Conohyus* type.

GROUP IV

DICORYPHOCHOERUS-SUS-PHACOCHOERUS

PROPOTAMOCHOERUS-POTAMOCHOERUS

HYOSUS-SIVAHYUS-HIPPOHYUS

This group is composed of a variety of genera rather closely related to each other, but which, nevertheless, represent a fairly wide range of adaptive radiation. These are the advanced and what we might call the "normal" suids. They are typified by the elongation of the skull, the complication of the cheek teeth, and by the various development of fighting tusks.

The genus *Dicoryphochoerus*, described by Pilgrim, may be considered as approximating the stem, or perhaps more properly the central branch of this phylogenetic group. *D. haydeni*, a species found in the Chinji zone of the Lower Siwaliks, would seem to represent the most primitive species of the genus, and consequently it would seem to be typical of the ancestor of this entire phylogenetic group. It is a medium-sized suid in which the cheek teeth have not developed the complexities so characteristic of the later members of this group. That is, the accessory conules so abundantly developed in the more advanced genera are, in this form, conspicuously absent, and the third molar is relatively short.

The later species of *Dicoryphochoerus* are considerably advanced over *D. haydeni*, both in size and in complexity of the cheek teeth. The species *D. titan* attains a size that might be called almost gigantic. In the phylogenetic advance of this genus, however, the tendency of the cheek teeth is to retain their primitive shortness, rather than to lengthen anteroposteriorly, as is the case with the genus *Sus*. Even *D. titan*, the most advanced species of the genus, has a third molar that is relatively

quite short, in spite of the degree of complexity that marks its crown pattern.

The genus *Sus* would seem to have branched out from the primitive *Dicoryphochoerus haydeni*. *Sus* has paralleled *Dicoryphochoerus* in its evolutionary history, but whereas the teeth of *Dicoryphochoerus* are short, the teeth of *Sus* become greatly elongated. These differences of phylogenetic expression are shown in the skulls of the two genera, correlative with their development in the teeth. The skull of *Dicoryphochoerus* is comparatively short and deep, whereas the skull of *Sus* is very long, with an elongated preorbital portion.

One of the Siwalik species, namely *Sus falconeri*, would seem to be more or less in a direct line leading to the genus *Phacochoerus*, now found in South Africa. *Sus falconeri* is quite a large pig in which the skull and the teeth are greatly elongated. The orbit of this Siwalik species is set far back, behind the last molar, a character foreshadowing the extreme posterior placement of the orbit in the wart hog. The glenoid of the Siwalik form is raised, and as a corollary to this the ascending ramus of the mandible is high. These again are characters found in *Phacochoerus*. Then again, the jugal of *Sus falconeri* is rather heavy, which would seem to be a development in the line of *Phacochoerus*. Turning to a consideration of the mandible, we see that the symphysis of the Siwalik species is heavy and long, much as it is in the African genus. The third molar of *Sus falconeri* is very suggestive of that tooth in *Phacochoerus*, because it is greatly elongated, and this elongation has caused the talon and the talonid to become divided into a longitudinal series of lateral and median conules, which when worn form a pattern that shows incipient stages toward the wart-hog pattern. Of course, *Phacochoerus* is a highly specialized pig and it shows many characters, such as the extreme reduction of the cheek dentition anterior to the last molar, the posterior, high orbit and the like, that are not found in *Sus falconeri*. Recently some Pleistocene phacochoeres have been described from South Africa by van Hoepen,¹ and some of these, notably the genus *Kolpochoerus*, help to bridge the gap between *Sus falconeri* and *Phacochoerus*. Thus it would seem reasonable to suppose that *Sus falconeri* of the Siwaliks is a species close to the point where the phylogenetic branch of phacochoeres split away from the normal pigs.

Another branch from the general *Sus* stem would seem to be that of the *Hyosus-Hippohyus* line. This branch is represented in ascending

¹Van Hoepen, E. C. N., and van Hoepen, H. E. 1932. 'Paleontologiese Navorsing van die Nasionale Museum, Bloemfontein,' II, Pt. 4, pp. 39-62.

order by the genera *Hyosus* and *Sivahyus* (possibly synonymous with each other) and by the genus *Hippohyus*. It was characterized by the development in the molar teeth of a very complex system of cones and conules, which when worn form an exceedingly complicated enamel pattern. Moreover, the teeth became quite hypsodont. On the other hand, the skull retained a primitive feature in that it remained rather short with a comparatively centrally placed orbit, and a rather short preorbital portion. The skull was specialized in the development of very heavy zygomatic arches. Although, at first glance, the teeth of *Hippohyus* would seem to be extraordinarily different from the usual pig tooth, they may be resolved, when subjected to a careful analysis, to the pattern characteristic of *Sus*. This shows the basic relationship of *Hippohyus* to *Sus* and it shows that the specializations in the former genus are those of degree rather than of kind.

Hyosus and *Sivahyus* are small genera with complexly folded enamel in the molars. They are directly ancestral to *Hippohyus*, which differs from them mainly by virtue of its greater size and its more hypsodont teeth.

Finally we come to a consideration of the genera *Propotamochoerus* and *Potamochoerus*. I cannot agree to Pilgrim's interpretation that these genera are widely divergent from *Dicoryphochoerus* and *Sus*. It would seem to me that they are, on the contrary, very close to the *Sus* line, and that their differences from the *Sus* branch of development are for the most part of a minor character. Pilgrim made a great point of the differences in the last lower premolar in these two groups. In the *Potamochoerus* line the last lower premolar consists of a single cone, with sometimes a very minute cone behind it and accessory upon it. On the other hand, in *Dicoryphochoerus* and *Sus* the last lower premolar has the form of a double cone, with the two apices closely appressed and either in line, one behind the other, or slightly oblique, so that the posterior one is somewhat internal to the anterior one. Other differences accompany these distinctions in the premolars. In the *Potamochoerus* group the cheek teeth are on the whole less complicated than they are in the *Sus* group, and likewise, the skull in the former group tends to be slightly stockier than it is in the latter group. But these, it seems to me, are not differences of fundamental import. Basically, on the evidence of skulls, jaws and teeth, the two groups of suids under discussion would seem to be very much like each other. Therefore, we may imagine them splitting apart late in the Tertiary period, retaining their similar *heritage* characters, but developing *habitus* characters that set them slightly

apart one from the other. It would seem logical to suppose that this division of the two groups occurred during Lower Siwalik times. *Propotamochoerus salinus* and *Dicoryphochoerus haydeni*, Chinji forms that may be taken as fairly well representative of the most primitive species of the two groups now under consideration, are certainly very much like each other.

Propotamochoerus is like *Potamochoerus*, but it is slightly more primitive in structure. The molar teeth are perhaps a little less complex in the former than they are in the latter, and the third molar is less elongate.

GROUP V

LOPHOCHOERUS

The genus *Lophochoerus* was erected by Pilgrim in 1926 to include some very small supposedly suid jaws from the Lower and Middle Siwaliks. As defined by Pilgrim, this genus is distinguished by its semi-selenodont molar teeth, in which respect it closely resembles the primitive but aberrant European Miocene suid, *Choerotherium*. Pilgrim distinguished this genus from *Choerotherium*, however, by its stout, conical P₄. The manner in which *Lophochoerus* is related to the other suids is a question of some difficulty. Pilgrim has suggested that it is an offshoot from the *Propotamochoerus*-*Potamochoerus* stem.

GROUP VI

SANITHERIUM

Sanitherium is a very small, rather aberrant genus of Siwalik suids, seemingly derived from the *Dicoryphochoerus*-*Sus* branch of phylogenetic development. It is characterized by its rather elongated molars, having infolded cusps, and by the beaded cingulum around the bases of the cheek teeth.

The accompanying figure presents a chart embodying the above outlined ideas concerning the phylogeny of the Siwalik Suidae. The several phylogenetic groups as presented in the foregoing paragraphs are indicated by branching lines, and the species most typical of them are placed at their proper stratigraphic levels. Only the species that are considered to be of true worth are included in this chart. A number of Pilgrim's species, which are possibly synonyms of the species placed on this chart, are not here included.

It will be noticed that the present phylogenetic chart differs from the chart outlined by Pilgrim in 1926 by its greater simplicity. This

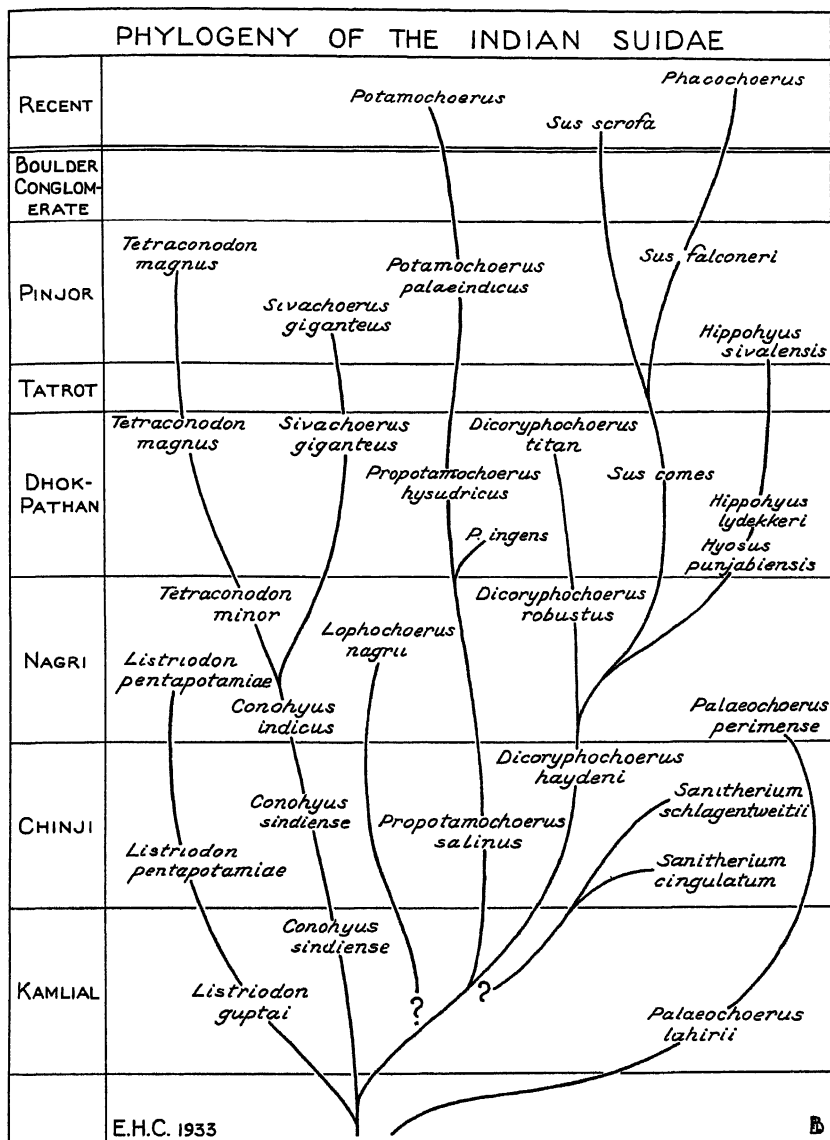


Fig. 1. Phylogeny of the Indian Suidae.

difference is due to certain fundamental differences of thought. Dr. Pilgrim considers the Suidae to be polyphyletic down to the base of the Eocene, but I consider the Suidae to be monophyletic through the earlier portions of the Tertiary period. According to my idea the pigs did not begin their adaptive radiation until some time in the Oligocene.

THE ORIGIN OF THE HIPPOPOTAMIDAE

Three explanations for the origin of the Hippopotamidae have been advanced during the course of the past hundred years. These are listed below.

1.—The Hippopotamidae have been derived from the Suidae, a view advocated by various authors, and recently supported by Matthew.

2.—The opposite theory is the one that would derive the Hippopotamidae from the Anthracotheriidae. This idea was especially supported by Andrews, but before him Falconer and Lydekker, had suggested a relationship between these two families, basing their conclusions particularly on the *Hippopotamus*-like habitus of the anthracotherine genus *Merycopotamus*.

3.—A recent theory has been advanced by Miss H. S. Pearson, who would derive the Hippopotamidae from certain Eocene bunodonts, notably *Cebochoerus*.

Good arguments may be elicited in favor of any one of these theories, for there can be found in the genus *Hippopotamus* characteristic pig, anthracotherine, and cebuchoerid features. The problem is: how to evaluate this assemblage of characters found in *Hippopotamus*, and to which ones emphasis should be given. Perhaps the problem is beyond solution at the present time, but at least it may be attacked, and the various possibilities presented by it may be carefully considered. Such a procedure will be attempted in the following pages.

CHARACTERS OF THE GROUPS UNDER CONSIDERATION

First let us turn to a brief review of the diagnostic characters of the Hippopotamidae, of the Anthracotheriidae, of the Suidae, and of *Cebochoerus* (often set apart as a separate family, the Cebuchoeridae).

HIPPOPOTAMIDAE

The primitive dental formula is retained except in the modern genus *Hippopotamus*, in which form one incisor, probably the second, is lost. In the more primitive genera the central incisor is of normal size, but in the advanced forms, such as *Hippopotamus*, this tooth is greatly en-

larged. The canines are large, directed vertically, and their surfaces are heavily striated longitudinally. The anterior premolars consist essentially of a single cone. The fourth premolar above and below is more complex, being made up of an outer and an inner cone in the upper tooth, and of two closely appressed lateral cones and a low posterior cone in the lower tooth. The molars are composed in each case of two pairs of trefoils, with the bases of the trefoils directed toward the midline of the tooth. There is no talon nor talonid in the last molars. All of the cheek teeth have well-developed cingula.

The skull in the Hippopotamidae is highly specialized. The orbit is elevated, with a well-developed postorbital bar. The maxilla is expanded above the heavy canine. The occiput is vertical and broad. The glenoid is low, being but little raised above the occlusal line of the molars. The paroccipital processes are short and the bullae are low and only moderately expanded. The basicranial foramina are coalesced around the bulla. The external auditory meatus is long and directed upward. The nasals are expanded at the base.

The mandible is very heavy, with a broad symphyseal region, and with a large, ventrally produced angle.

The body is heavy, and the legs are relatively short. The foot has four functional toes.

ANTHRACOTHERIIDAE

In the anthracotheres there is a full dental formula. The canines are directed vertically and are rather large. The premolars are simple, being composed of a single cone in the anterior members of the series, and of an outer and an inner cone in the fourth upper premolar. The molars are bunio-selenodont, the upper ones consisting of four crescentic cusps (with a fifth cusp, the protoconule present in the more primitive forms), and the lower ones consisting of two outer crescentic cusps and two inner conical cusps. There is a well-developed talonid in the last lower molar.

The primitive Eocene anthracotheres have an unspecialized skull, but in some of the more advanced Pliocene and Pleistocene forms the skull becomes highly specialized. The genus *Merycopotamus*, found in the Upper Siwaliks, has an elevated orbit, whereas the more primitive genera do not have the orbit raised. The occiput of the anthracotheres tends to be rather broad, especially in the larger and heavier forms. The glenoid is relatively low. The paroccipital processes are short and the bullae are low and but moderately expanded. The external auditory

meatus is rather short. The basicranial foramina are quite separate in the primitive forms, but in some of the advanced genera, such as *Merycopotamus*, they are coalesced around the bulla—an advanced artiodactyl character.

The mandible is characterized by its shallow horizontal ramus. In *Merycopotamus* the symphysis is very heavy and broad, and the angle is produced ventrally in a manner extraordinarily similar to the ventrally produced angle in the Hippopotamidae.

Merycopotamus is a heavy bodied animal; the more primitive anthracotheres are naturally more slenderly built. The foot is functionally four-toed.

SUIDAE

The full dental formula is retained in the primitive pigs, but in some of the specialized genera there may be a reduction of incisors, premolars, and molars. The canines are almost invariably directed outward, or outward and upward. The cheek teeth are bunodont, and in the more advanced suids there is a strong tendency toward the production of numerous accessory conules. The premolars are rather complicated, so that even in the anterior members of the premolar series there is generally a high cone or two appressed cones, with a low internal shelf in the upper teeth and a low posterior heel in the lower teeth. The last upper premolar usually consists of two outer cones and one inner cone, but the last lower premolar is made up of the characteristic high central cone or cones and the low heel. In the primitive suids the molars consist, each one, of four simple cones, and in the last molars above and below there are simple talons and talonids. Very early, however, in the phylogenetic history of the Suidae there is a very strong tendency toward elongation of the molars, especially the third molar, and the production of numerous accessory conules. The last molar may become extremely long, by a process of lengthening the heel, and the cusps may become quite numerous.

The skull in the Suidae is marked by its tendency to elongate, especially in the preorbital region. This is accomplished not only by a drawing out of the face but also by a backward and sometimes an upward migration of the orbit. The zygomatic arch tends to expand, both laterally and vertically. The glenoid is invariably high, so that the mandibular articulation is raised above the occlusal line. As a corollary to this high glenoid, the paroccipital processes are long, and the bullae are expanded ventrally. The basicranial foramina are coalesced around the

bullae, except in the most primitive suids. The external auditory meatus is long and directed upward. The occiput is narrow, and it overhangs the condyles.

The mandibular symphysis is narrow and the angle is not produced ventrally. The ascending ramus is high.

The body is compact, and the legs are moderately long. There are but two functional toes; the lateral digits, although well developed, do not touch the ground.

CEBOCHOERUS

Cebochoerus is an Eocene artiodactyl from Europe. Although it is primitive in its general aspect, it does show certain well-marked specializations that set it apart as a definitely aberrant form. The full dental formula is retained, at least in the mandible. There is some reason to believe that some of the upper incisors were absent. The upper canine is rather small and vertical, and the lower canine is incisiform and in series with the incisors. Both upper and lower first premolars are specialized to assume the function of canines. The other premolars are simple in the mandible, but in the maxilla the fourth premolar is laterally expanded so that it consists of an outer and an inner cusp. The molars are quadrate above with five cusps, and below they are but slightly elongated and have four cusps. There is a very small talonid in the third lower molar. Accessory cusps and cingula are lacking.

The skull of *Cebochoerus* is short and deep, with the orbit centrally placed. The occiput is vertical and very broad, resembling in this respect, and to a certain degree, the occiput in the anthracotheres or the hippopotamuses. The glenoid is low, being raised but little above the occlusal line, and as an accompaniment to this character the paroccipital processes are short. The bulla is small and the basicranial foramina are separate, as might be expected in a genus of Eocene age. The external auditory meatus is short and extended laterally. The zygomatic arch is rather long, but it is not specialized in any way.

The mandible is very deep, especially in the posterior portion. The symphysis is fairly heavy and the ascending ramus is low and wide.

The skeleton is imperfectly known.

These are the salient characters of the several mammalian groups being considered in connection with the problem of the origin of the Hippopotamidae. Let us now turn to an evaluation of the resemblances and differences between these several types of mammals, in an attempt to discover which of them is most closely related to the Hippopotamidae.

We will first discuss, in a comparative fashion, the resemblances and differences existing between the Hippopotamidae, the Suidae, and the Anthracotheriidae.

A COMPARISON OF THE HIPPOPOTAMIDAE, ANTHRACOTHERIIDAE, AND SUIDAE

A.—DENTITION

If the *Hippopotamus* molar pattern was derived from the suid molar pattern the following steps were involved.

- 1.—Coalescence of certain accessory conules with the primary cusps of the suid molar, to form the trefoil of the hippopotamid molar.
- 2.—Suppression of all superfluous accessory conules.
- 3.—Shortening of the tooth and the elimination of the heel in the third molar.

If the *Hippopotamus* molar pattern was derived from the anthracotherine molar pattern, this derivation followed the following phylogenetic course.

- 1.—Transformation of the anthracothere crescents into the *Hippopotamus* trefoils.

It at once becomes apparent that the steps involved in the transformation of an anthracotherine molar into a *Hippopotamus* molar are much simpler than those required for the change of a suid molar into a *Hippopotamus* molar, a fact that favors the view that the Hippopotamidae may have been derived from the anthracotheres.

The manner in which the anthracothere or the suid molars may have been changed into a *Hippopotamus* molar are shown in the accompanying illustration (Fig. 2).

Perhaps it might be well at this point to make a few explanatory remarks regarding the figure illustrative of the discussion now being presented.

Conohyus is chosen as a fairly primitive suid, of a kind that might have been structurally ancestral to the Hippopotamidae. If the Hippopotamidae were derived from the Suidae, they must have sprung from some primitive type of suid, because all of the more advanced pigs trend away from the *Hippopotamus* habitus too definitely to be considered as probable ancestral forms. Even *Conohyus* is probably far too advanced along the suid habitus to constitute a very good ancestral type. It is used here because it is rather primitive, and because it is known from complete dentitions, a skull and a mandible. *Merycopotamus* is

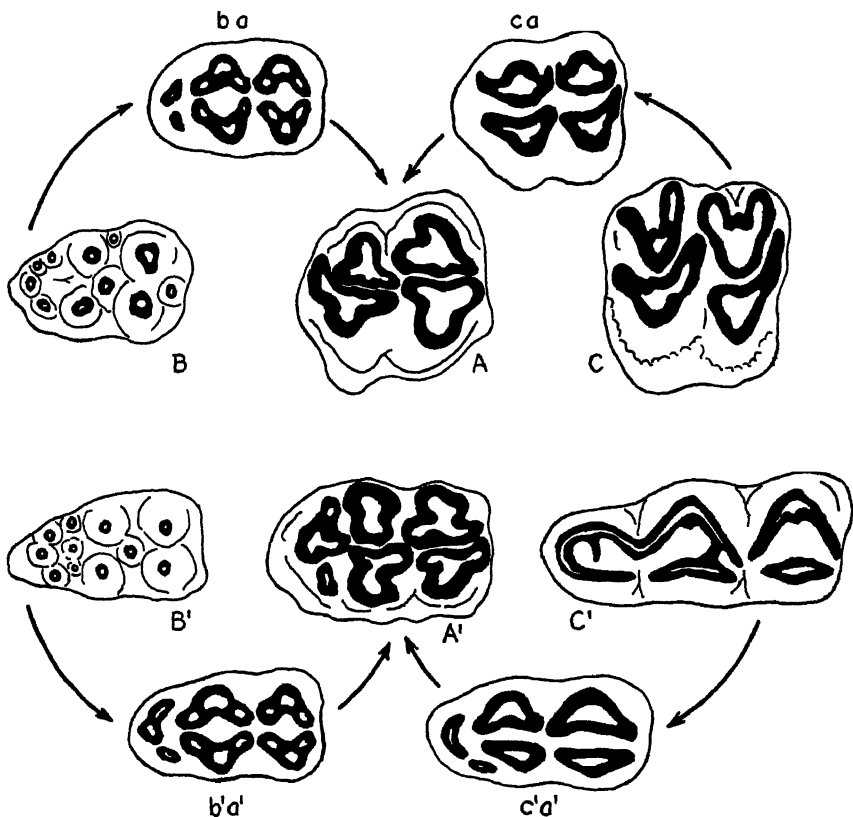


Fig. 2. The origin and evolution of the tooth pattern in the Hippopotamidae.

A, A'. Upper and lower third molars of *Hexaprotodon sivalensis*.

B, B'. Upper and lower third molars of *Conohyus sindiense*.

C, C'. Upper and lower third molars of *Merycopotamus dissimilis*.

ba, b'a'. Hypothetical intermediate stages between the Suidae and the Hippopotamidae.

ca, c'a'.

the Hippopotamidae.

From Falconer and Cautley, Forster Cooper and Pilgrim. Figures not to scale.

chosen as an anthracothere approximating to a considerable extent the type that might have been ancestral to the Hippopotamidae. Really primitive hippopotami are not known, a fact the significance of which will be pointed out below, so it becomes necessary to use a form not greatly different from the modern *Hippopotamus*. *Hexaprotodon*, from the Siwaliks, is chosen, because it is slightly more primitive than *Hippopotamus*, and because it is known from adequate material.

On the left side of the chart are shown the steps involved in the transformation of a primitive suid molar into an *Hippopotamus* molar. This change involves the concrescence of accessory conules with the primary cones, to form trefoils, and in addition, a distinct shortening of the tooth.

On the right side of the chart are shown the steps involved in the transformation of an advanced anthracothere molar into a *Hippopotamus* molar. This change involves in the upper molars the expansion of the "barrels" of the paracone and the metacone and the suppression of the inner crescents of these two cusps, and concomitantly a buccal growth of the inner portion of the protocone and of the metaconule. In the lower molars there would have been a lingual growth of the protoconid, metaconid, entoconid, and hypoconid.

Considering now the premolar teeth, we see that the *Hippopotamus*, anthracothere, and suid premolars are all very much alike. In the last upper premolar of the Suidae, however, there are two outer cusps and one internal cusp, whereas in the Hippopotamidae and the Anthracotheriidae there is but one outer cusp. In some of the anthracotheres, especially such genera as *Gelasmodon* or *Merycopotamus*, the lower premolars are strikingly similar to those in *Hippopotamus*.

The Hippopotamidae and the Anthracotheriidae are characterized by their vertically directed canines, whereas the Suidae have laterally directed canines.

B.—SKULL AND MANDIBLE

In the skull and mandible there is a marked resemblance between the Hippopotamidae and some of the advanced Anthracotheriidae, such as *Merycopotamus*. The following characters are common to these two families (as expressed in the Anthracotheriidae by advanced genera).

- 1.—Elevation of the orbit.
- 2.—Position of the infraorbital foramen.
- 3.—Shape of the zygomatic arch.
- 4.—The broad, vertical occiput.
- 5.—The low, wide glenoid. (Secondarily raised in *Merycopotamus*.)

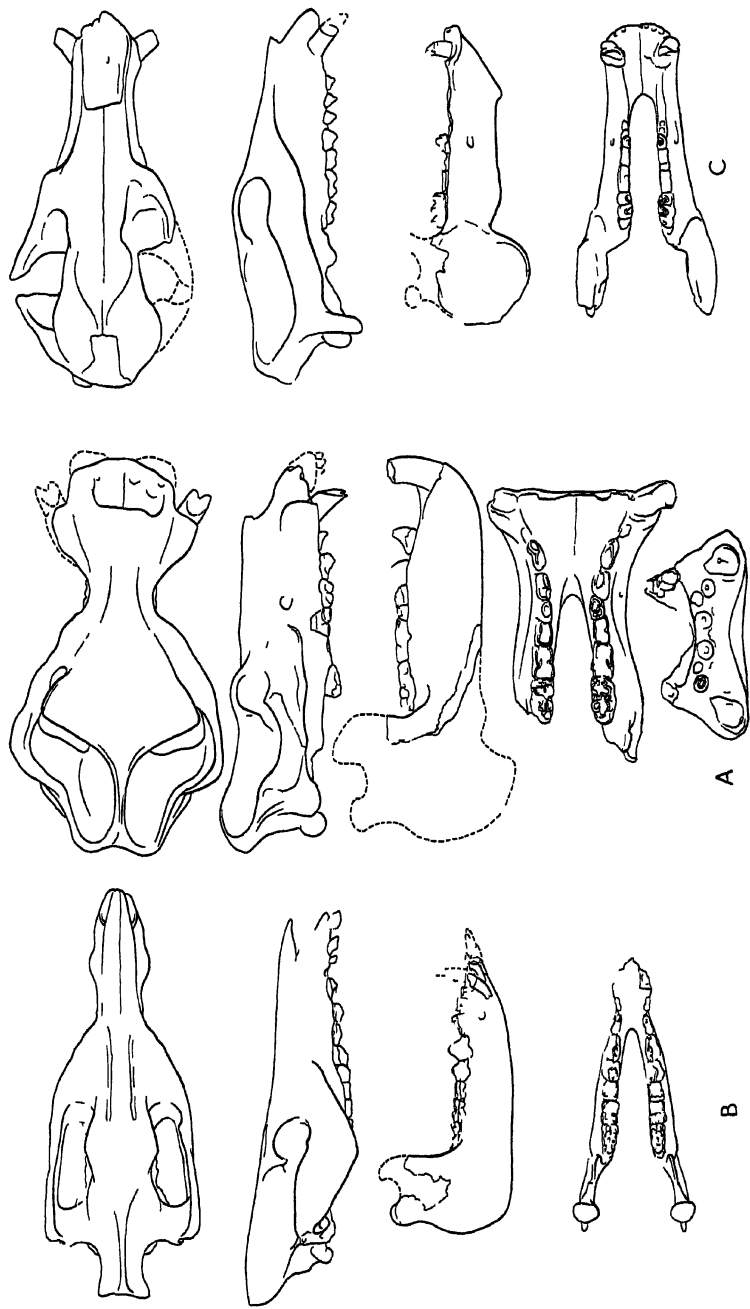


Fig. 3. Comparison of the skull and mandible in the Hippopotamidae, the Suidae, and the Anthracotheriidae. *Hezaprotodon sivalensis*, Upper Siwaliks. B. *Conohyus sindhense*, Lower Siwaliks. C. *Merycopotamus dissimilis*, Upper Siwaliks. The front view of the mandibular symphysis of *Hezaprotodon* is included to show the diminution in size of the second incisor. From Falconer and Cautley, and Colbert. Figures not to scale.

- 6.—The short paroccipital processes.
- 7.—The general configuration of the auditory bulla.
- 8.—The postglenoid compression.
- 9.—The high mandibular coronoid.
- 10.—The deep angle of the mandible.
- 11.—The broad mandibular symphysis.

In comparing the *Hippopotamus* skull and mandible with those of the pig, we find the following characters common to both families.

- 1.—Elevation of the orbit (in certain specialized suids).
- 2.—The postglenoid compression.
- 3.—The expanded maxilla for the accommodation of the large canine.
- 4.—The long tube for the external auditory meatus, opening in an upward direction.

From the above it will be seen that there is a great preponderance of like skull and jaw characters in the Hippopotamidae and the Anthracotheriidae, as compared with the characters common to the Hippopotamidae and the Suidae. Of course the above lists may not be strictly diagnostic of the real resemblances and differences in these groups. Some of the above outlined characters may very well be due to parallelisms, rather than to direct genetic relationships. It seems difficult, however, to account for many of the resemblances in the skulls of the Hippopotamidae and the Anthracotheriidae as due entirely to parallel evolution. The shape of the occiput, the low glenoid, the short paroccipital processes, the auditory bulla, and the form of the mandible would seem to be characters that, when taken together, are significant of a probable relationship between the Hippopotamidae and the Anthracotheriidae.

Moreover, the entire trend of evolution in the suid skull and jaw, from the Oligocene on, is *away* from the hippopotamus habitus, whereas the trend of evolution in the anthracothere skull and jaw is seemingly *toward* the hippopotamus habitus. It may be that the numerous resemblances between the skull and jaws in the advanced anthracotheres and in *Hippopotamus* are entirely fortuitous, but, if so, they require for their explanation an unusual degree of parallelism in these two families.

In a recent number of the Journal of Anatomy, Miss H. S. Pearson¹ discusses in some detail the hinder end of the skull in *Merycopotamus* and in *Hippopotamus*. She concludes that *Merycopotamus* is a true anthracothere, and that it does not show any closer affinities to the Hippopotamidae than do any of the other anthracotheres. After a detailed consideration of the skull of *Hippopotamus minutus* she decides that the

¹Pearson, H. S. 1929. Journal of Anatomy, LXIII, pp. 237-241.

fossil specimen is essentially similar to the modern species, and that any differentiation must needs be made on the basis of the teeth.

It may be that *Merycopotamus* is no closer in the structure of its skull to the Hippopotamidae than are any of the other anthracotheres. But the fact remains that the anthracotheres, as a group, do show many significant similarities in skull structure to the Hippopotamidae, as has been pointed out in the preceding pages.

C.—SKELETON

Coming now to the skeleton, we see that such comparisons as may be made suggest the probability of relationships between the Anthracotheriidae and the Hippopotamidae. Andrews¹ has noted the similarity in the pelvis of *Brachyodus*, an anthracothere from the Fâyum deposits of Egypt, and *Hippopotamus*.

"—these animals [i. e., the anthracotheres] in many points, e.g. in the pelvis (see p. 185), approach very nearly to the Hippopotamidae, which were probably derived from them. Remains of one of the earliest and most primitive Hippopotami known, viz. *H. hipponensis*, have already been found in the Middle Pliocene of Egypt, so that there is every prospect that annectant forms between *Hippopotamus* and the Anthracotheres may be discovered in this region in deposits between the Lower Miocene and the Pliocene."

In concluding a description of the pelvis of *Brachyodus* this same author² makes the following remarks.

"This arrangement is also found in a very similar pelvis of *Brachyodus africanus* from Maghara and in *Hippopotamus*: this last genus, in fact, seems to be intimately related with the African Anthracotheres, and annectant forms similar to *Merycopotamus* will probably be discovered in the Miocene beds between Maghara and the Wadi Natrun, in the Lower Pliocene deposits of which remains of a primitive Hippopotamus have already been found."

In the Suidae the pelvis is narrow as compared to the pelvis in the Anthracotheriidae and the Hippopotamidae, and the ilia are not flared. Other minor differences are to be noted.

Then, in comparing the tarsus of the forms under consideration, a close resemblance is to be seen in the broad astragalus of the advanced anthracotheres and the hippopotami, whereas the astragalus in the pigs is narrow.

¹Andrews, C. W. 1906. 'A Descriptive Catalogue of the Tertiary Vertebrata of the Fâyum, Egypt' London, p. xx.

²Andrews, C. W. 1906. *Op. cit.*, p. 186.

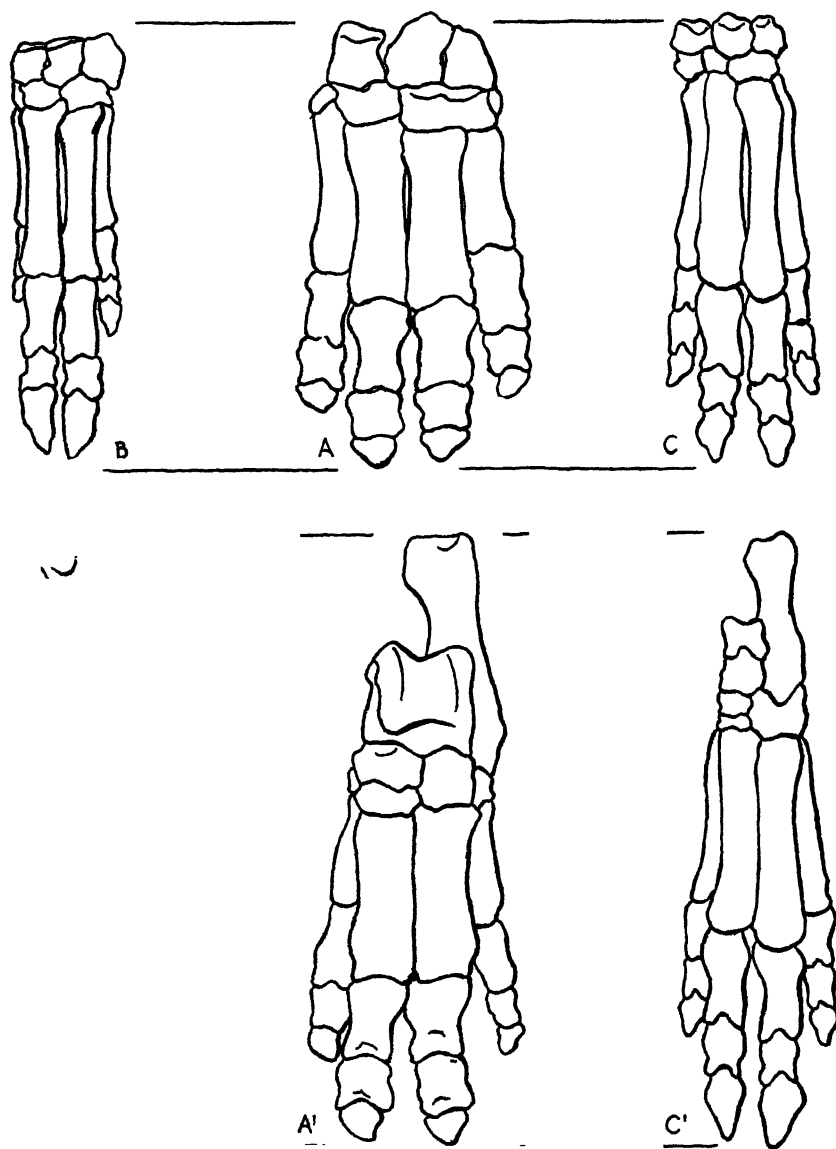


Fig. 4. Comparison of the manus and pes in the Hippopotamidae, the Suidae, and the Anthracotheriidae.

A, A'. Manus and pes of *Hippopotamus amphibius*.

B, B'. Manus and pes of *Sus scrofa*.

C, C'. Manus and pes of *Anthracotherium brachyrhynchus*.

From de Blainville, Scott and others. Figures not to scale.

Of course these skeletal characters may be due to the adaptations of the anthracotheres and the hippopotami to the increase in body weight, necessitating at least semi-graviportal structures, as compared to the cursorial adaptations in the suids. The fact remains, however, that the largest anthracotheres were no larger than large pigs, yet in many of their skeletal characters, notably in the pelvis and the feet, they showed a trend toward the *Hippopotamus* habitus rather than one toward the Suidae.

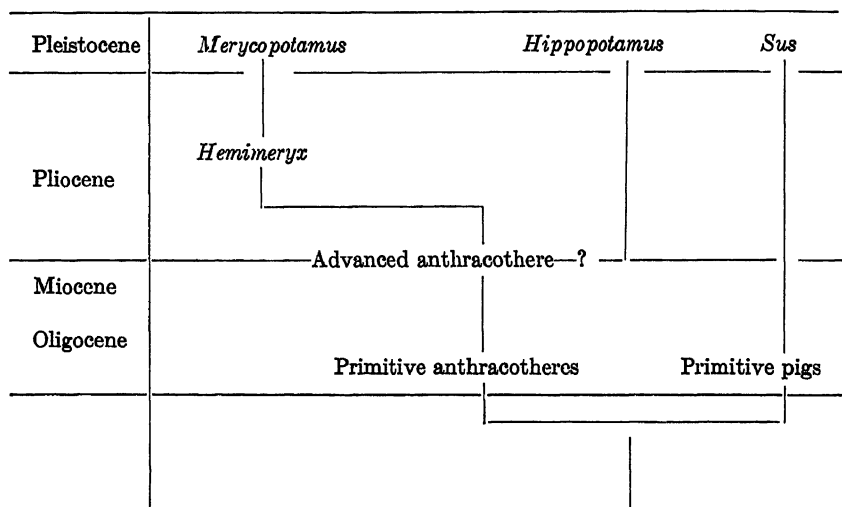
Taking the evidence all in all it will be seen that resemblances exist between the anthracotheres and the hippopotami and between the pigs and the hippopotami. It would seem to me, however, that the anthracothere-hippopotamus resemblances are certainly more numerous and probably more convincing than the pig-hippopotami resemblances. A definite and a final solution of this vexing problem of the origin of the Hippopotamidae is difficult to reach, because the evidence is peculiarly suited to factors of individual interpretation. The most primitive Hippopotamidae known are not appreciably different from the modern forms. Thus it becomes necessary to use many advanced, specialized habitus characters in drawing our comparisons, and these tend to mask, or rather to crowd out, the more significant primitive heritage characters, the characters on which phylogenetic ties between groups must ultimately rest.

I have attempted to show in the above remarks that the trend of evolution has been similar in the Anthracotheriidae and the Hippopotamidae, whereas the evolutionary trend in the Suidae has been on the whole quite unlike the trend in the Hippopotamidae.

Furthermore, it seems to me that Andrews made an unusually sagacious remark when he said "that there is every prospect that annectant forms between *Hippopotamus* and the Anthracotheres may be discovered in this region [Egypt] in deposits between the Lower Miocene and the Pliocene." We do not know any primitive Hippopotamidae from the earlier portion of the Tertiary. May not this be due to the fact that the Hippopotamidae is a family of late evolutionary development, a family that broke away from its ancestral group in the late Miocene? It may be that primitive, early Tertiary Hippopotamidae have never been found because such animals never existed.

If the Hippopotamidae did break away from an ancestral stem in the late Miocene, what might this stem have been? Certainly not the pigs, which by that time had become set in an evolutionary trend quite away from the *Hippopotamus*-type of structure. Why not, therefore,

the anthracotheres, which in the Upper Tertiary show numerous structural characters strongly suggestive of the Hippopotamidae? Perhaps the great similarity of *Merycopotamus* to *Hippopotamus* is due to the fact that the former is not far removed from the *advanced* anthracothere type, from which the latter may have been derived. This suggestion may be represented diagrammatically as follows.



In the above discussions the arrangement of the basicranial foramina in the Anthracotheriidae, the Suidae, and the Hippopotamidae was not utilized for comparisons, because of the similarities existing among the advanced forms of the first two families and of the Hippopotamidae. In all of these families the foramina are coalesced around the bulla, a common character in the more specialized artiodactyls.

WAS *Cebochoerus* ANCESTRAL TO THE HIPPOPOTAMIDAE?

Miss H. S. Pearson has suggested that the Hippopotamidae may have been derived from *Cebochoerus* of the Eocene of Europe. She bases her argument on the following characters common to or similar in both groups.

- 1.—The shape of the glenoid.
- 2.—The position of the glenoid.
- 3.—The position of the post-tympanic, anterolateral to the par-occipital.

Although there are resemblances between *Cebochoerus* and the Hippopotamidae in the above-mentioned characters, many differences, which it seems to me are of greater importance, may be found. The skull and the dentition especially, of *Cebochoerus*, are specialized along a quite definite trend, not toward the Hippopotamidae, but rather in a direction of their own.

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DISTRIBUTIONAL AND PHYLOGENETIC STUDIES ON INDIAN FOSSIL MAMMALS. V

THE CLASSIFICATION AND THE PHYLOGENY OF THE GIRAFFIDAE

By EDWIN H. COLBERT

INTRODUCTION

During the later portions of Tertiary times northern India was a great center for the adaptive radiation of the Giraffidae. In the Siwalik deposits of Upper Miocene, Pliocene, and Pleistocene age there is a considerable assemblage of fossil giraffes of varied form, and a study of these Siwalik giraffes throws a great deal of light on the problem of the evolution and the classification of the Giraffidae. A recent review of the fossil giraffes in the Siwalik collection of The American Museum of Natural History has suggested to the present author certain considerations regarding the classification and the phylogeny of the Giraffidae. Some of the questions having to do with the evolution and the classification of this family of artiodactyls will be discussed below.

PREVIOUS CLASSIFICATIONS OF THE GIRAFFIDAE

Some of the more important classification schemes for the Giraffidae are those of Murie (1871), Rüttimeyer (1881), Lydekker (1882), von Zittel (revised edition, 1925), Pilgrim (1911), Abel (1919), Bohlin (1927), and Matthew (1929).

MURIE, 1871

In 1871 Dr. James Murie published a paper in the Geological Magazine entitled, 'On the Systematic Position of the *Sivatherium giganteum* of Falconer and Cautley,' in which he discussed the relationships of *Sivatherium* to *Bramatherium* and to other artiodactyls. Basing his conclusions on the development of the horn cores, Murie was led to believe that *Sivatherium* and *Bramatherium* are closely related to the Antilocapridae and to the saiga antelope. He stipulated that the connections between *Sivatherium* and the modern giraffe are of minor importance. Although Murie did not outline a classification for the fossil Giraffidae, he did present a sort of phylogenetic diagram in which he showed *Sivatherium* as being directly related to *Bramatherium*, to the saiga and to the

pronghorn antelope. He interposed the Antilocapridae and the Cervidae between *Sivatherium* and *Giraffa*.

RÜTIMEYER, 1881

Rütimeyer, in his 'Natürliche Geschichte der Hirsche,' published in 1881, failed to realize the relationships existing between the large Siwalik giraffes and the modern giraffe. He placed *Giraffa* among the Cervina, as closely related to the elk. *Helladotherium* from Pikermi was considered as being related to the giraffe, and consequently it was placed with the giraffe among the deer. *Sivatherium*, *Bramatherium*, and *Vishnutherium* from the Siwaliks were assigned to a position among the antelopes, contiguous to the *Damalis* group of South Africa.

LYDEKKER, 1882

It remained for Lydekker to show, in his large monograph on the Siwalik Camelopardalidae published in 1882, that the Siwalik genera, *Sivatherium*, *Hydaspthierium*, *Bramatherium*, etc., are true giraffes, directly related to the modern *Giraffa* and to such fossil forms as *Helladotherium* from Pikermi. Lydekker's realization that these several fossil forms are true giraffes, and that they should be combined with the modern giraffe in one family, is a distinct advance over the views of previous authors.

Lydekker did not divide the Camelopardalidae, as he called it, into lesser groups or subfamilies, but he did arrange the seven genera which he considered as constituting the family in a certain "order of their relationship to one another, indicating a gradual diminution in the length of the limbs and of the neck from the giraffe to the sivathere." Lydekker's arrangement was as follows.

Camelopardalis = *Giraffa*

Orasius

Vishnutherium

Helladotherium

Hydaspthierium

Bramatherium

Sivatherium

This arrangement is valid in that it indicates the relationships of *Orasius* to *Giraffa* and it groups the large giraffids together. Lydekker considered the Camelopardalidae as most closely related to the Cervidae.

VON ZITTEL (revised edition, 1925)

The English translation of von Zittel's 'Textbook of Palaeontology,' published in 1925, includes the Giraffinae and the Sivatheriinae as two

separate subfamilies among the family Cervicornia. The arrangement is as follows.

Family Cervicornia

Subfamily 1.—Moschinae

2.—Cervulinae

3.—Cervinae

4.—Protoceratinae

5.—Giraffinae

6.—Sivatheriinae

According to this classification the genera constituting the two subfamilies are as follows.

Giraffinae

Helladotherium

Palaeotragus

Samotherium

Camelopardalis

Sivatheriinae

Sivatherium

Bramatherium

Hydaspietherium

PILGRIM, 1911

In 1911, Dr. Pilgrim published a memoir entitled 'The Fossil Giraffidae of India.' Although this work was directly concerned only with the Siwalik giraffes, it contained a supplementary consideration of the evolution of the Giraffidae. On page 29 of the publication under consideration there is a phylogenetic diagram of the Giraffidae which classifies the family in the following manner.

GIRAFFIDAE

Palaeotraginae

Palaeotragus

Samotherium

Alcicephalus

Okapia

Indratherium

Libytherium

Helladotheriinae

Helladotherium

Vishnutherium

Giraffokeryx

Progiraffinae

Progiraffa

Giraffinae

Giraffa

Orasius

Sivatheriinae

Sivatherium

Hydaspietherium

Bramatherium

Urmatherium (placed here rather than in the Bovidae)

This classification is marked by the multiplication of subfamilies, of which one, the Progiraffinae, is founded on rather scanty material, and another, the Helladotheriinae, consists of genera that might very well be placed within two different but well-established groups, the Palaeotraginae and the Sivatheriinae. This will be discussed more fully below.

ABEL, 1919

Abel's classification of the Giraffidae, published in 1919 in his 'Stämme der Wirbeltiere,' is essentially the same as that of von Zittel. He divides the family into two subfamilies, the Giraffinae and the Sivatheriinae.

BOHLIN, 1927

In 1927 Birger Bohlin published an elaborate monograph, 'Die Familie Giraffidae,' a very thorough study of the giraffes, with the fossil material collected by the Swedish expeditions in North China serving as its basis. His classification of the family is given below.

GIRAFFIDAE

Palaeotraginae

Palaeotragus

Giraffokeryx

Achtiaria

Samotherium

Alcicephalus

Chersonotherium

Shanshitherium

Giraffinae

Giraffa

Honanotherium

Orasius

Okapiinae

Okapia

Sivatheriinae

Sivatherium

Indratherium

Bramatherium

Hydaspitherium

Helladotherium

Griquatherium

Vishnutherium

Libytherium

[Progiraffinae]

[*Progiraffa*]

Bohlin's classification is the most comprehensive and perhaps the best of all the proposed schemes of giraffid taxonomy. His creation of a separate subfamily for the okapi may be disputed; a discussion of this question will be offered below.

MATTHEW, 1929

Dr. Matthew, in his 'Critical Observations upon Siwalik Mammals,' pointed out the desirability of including *Okapia* among the Palaeotraginae, thereby making three subfamilies of the Giraffidae instead of four

(exclusive of the "Progiraffinae"). Matthew's classification is given below.

GIRAFFIDAE

Palaeotraginae

Palaeotragus

Samotherium

Giraffokeryx

Okapia

Giraffinae

Giraffa

Orasius

Honanotherium

Sivatheriinae

Sivatherium+*Indratherium*

Helladotherium+*Bramatherium*

Hydaspitherium

THE RELATIONSHIPS OF *Okapia*

A careful consideration of the problem of a classification of the Giraffidae will demonstrate the validity of Dr. Matthew's views as to the inclusion of *Okapia* in the Palaeotraginae. Bohlin's separation of the okapi into a distinct subfamily is seemingly a flaw in his otherwise admirable classification of this group of artiodactyls. It would seem as if he has placed too much emphasis on minute, and for the most part unimportant characters, and in doing this he has disregarded the great preponderance of characters that typify *Okapia* as a truly primitive palaeotragine. *Okapia* is, in all of its essential characters, a structurally primitive Miocene giraffe (more primitive than *Palaeotragus* or *Samotherium*) that has persisted on to the present day in a region conducive to the continuation of such an early form.

Bohlin has separated the okapi from the Palaeotraginae because:

- 1.—The frontals are narrow in the modern form, as compared to the fossil species.
- 2.—The horns are placed in a slightly different position in *Okapia* from the positions of the horns in *Palaeotragus* or *Samotherium*.
- 3.—The frontals in the okapi tend to develop pneumatic sinuses within them, whereas the sinuses are not pronounced in *Palaeotragus* and related genera.
- 4.—There are minor differences in the dentition; there is no outer cingulum on DM² in the okapi, whereas in *Palaeotragus* and *Samotherium* this cingulum is present.
- 5.—The skeleton of the okapi differs in small details, especially those of proportions, from the skeleton of *Palaeotragus*.

These are differences of minor importance. Now let us look at *Okapia* and the fossil Palaeotraginae for the purpose of making comparisons between major anatomical characters.

The skull of *Okapia* is in most respects more primitive than the skull of the fossil Palaeotraginae. The canine-premolar diastema of the mandible is much shorter in the okapi than it is in the fossil forms, showing that the modern species has retained a short muzzle, a primitive and a diagnostic heritage character. In the okapi the frontals are narrow, which is to be expected in a relatively primitive artiodactyl. In *Palaeotragus* the frontals are wide, and this may be considered as an habitus character, subsequent to the narrow frontal region. An examination of various groups of ungulates will show that the skull tends to elongate first, after which it widens, if the tendency to widen exists at all. That is, elongation precedes lateral expansion. Consequently we may expect a primitive giraffid, such as the okapi, to have a narrower frontal region than a more advanced form in which the cranium has broadened out.

Of course, as Bohlin has shown, the frontals of the okapi contain rather large sinus cavities, which are lacking in *Palaeotragus* and *Samotherium*. It may be quite probable that the development of the frontal sinuses in the okapi are of a secondary nature, and that they have been acquired more or less independently in the long period of time that has elapsed between the Miocene and the present day. But this is no reason for excluding the okapi from a place as a relatively primitive palaeotragine. It is a primitive genus that has developed certain specialized characters during the passage of geologic time.

In *Okapia* the horn cores are rather small, whereas in *Palaeotragus* they are much larger. Thus we may regard the okapi as more primitive in its horn development than is *Palaeotragus*. Of course, one might argue that the small horns in the okapi are degenerate structures, secondarily reduced from larger horns, but in answer to this argument it might be said that the horn cores in the okapi have retained a primitive position over the orbit, and this would favor their being truly primitive structures. This primitive position of the horn cores is retained in *Palaeotragus*, but in *Samotherium* the horn cores have shifted somewhat to the rear, due to the elongation of the skull.

In *Okapia* the dentition is very brachyodont—a primitive character. In *Palaeotragus* and *Samotherium* the teeth are considerably higher than is the case in the modern genus, showing that the fossil forms are relatively advanced in the stage of their phylogenetic development.

The skeleton of the okapi is certainly primitive. It shows little of the elongation of the limbs, or of transverse growth of the skull and skeletal elements that appear in the more advanced Giraffidae.

Therefore, considering *Okapia* with regard to its major anatomical characters, without special emphasis on small, single features, we see that it is a very primitive giraffid, more primitive even than *Palaeotragus*, and that it is a satisfactory structural ancestor for the Palaeotraginae. It has the diagnostic heritage characters of the Palaeotraginae, but in this persistent genus very few of the advanced habitus characters that characterize the fossil genera have been developed.

THE RELATIONSHIPS OF *Giraffokeryx*; OTHER PROBLEMS

The genus *Giraffokeryx* was created by Pilgrim in 1910, on the basis of upper and lower cheek teeth. In 1911, this author, in his monograph of the Siwalik Giraffidae, placed *Giraffokeryx* along with *Helladotherium* and *Vishnutherium* in a separate subfamily, the Helladotheriinae. Bohlin, in 1927, went to the other extreme and reduced the genus *Giraffokeryx* to synonymy with *Palaeotragus*, including it, naturally, in the subfamily Palaeotraginae. Both of these authors were founding their conclusions on the evidence of teeth alone.

An almost complete skull of *Giraffokeryx* in the American Museum gives much evidence that helps to solve the question of the taxonomic position of the genus. This skull has recently been described by Colbert (1933), and it is shown to be essentially a *Palaeotragus*-type with an extra pair of horn cores on the frontals. Therefore the genus *Giraffokeryx* properly belongs in the subfamily Palaeotraginae, where it was placed by Bohlin and later by Matthew. It is, however, a separate genus, quite distinct from *Palaeotragus*, but closely related to it.

Bohlin and Matthew have both given conclusive evidence to show that the genera *Helladotherium* and *Vishnutherium* should be included in one subfamily with *Sivatherium*, *Hydaspietherium*, *Bramatherium*, etc. Consequently Pilgrim's subfamily Helladotheriinae would seem to be unnecessary.

The subfamily Progiraffinae, created by Pilgrim in 1911, is based on rather insufficient material. The genus *Progiraffa* (*Propalaeomeryx*) may be perfectly valid, and it may deserve separation from the other Giraffidae as a distinct subfamily, but at the present time the material is not plentiful enough to prove this. Until further material is discovered it would seem best to include this genus tentatively among the Palaeotraginae.

The reader is referred to Matthew's 'Critical Observations upon Siwalik Mammals,' published in 1929, for illuminating notes and discussions concerning the Siwalik Giraffidae.

With the foregoing discussion in mind we may now attempt a new classification scheme for the Giraffidae.

CLASSIFICATION OF THE GIRAFFIDAE

GIRAFFIDAE

Large, ruminating artiodactyls, with heavy, rugose cheek teeth. The skull may or may not have horn cores, but if they are present they show a great variety of development. Bones of cranial roof pneumatic. Lateral metapodials and digits atrophied.

Palaeotraginae

Primitive, medium sized giraffids, having as a rule one pair of supra-orbital frontal horn cores. There may be a second pair of horn cores at the anterior extremities of the frontals. Horn cores in the form of simple tines, well developed in the males, feebly developed or absent in the females. Skull usually elongated.

Cheek teeth brachyodont, with moderately coarse sculpture of the enamel. Limbs and neck slightly elongated.

PALAEOTRAGUS Gaudry, 1861

Palaeotragus rouenii Gaudry—Generic type. Pontian, Lower Pliocene; Pikermi, Samos.

Palaeotragus parvus (Weithofer). Synonym of *P. rouenii*.

Palaeotragus vetustus (Wagner). Synonym of *P. rouenii*.

Palaeotragus microdon (Koken). Pontian, Lower Pliocene; China.

Palaeotragus coelophrys (Rodler and Weithofer). Pontian, Lower Pliocene; Maragha, China.

Palaeotragus decipiens Bohlin. Pontian, Lower Pliocene; China.

Palaeotragus quadricornis Bohlin. Pontian, Lower Pliocene; Samos, Maragha, China.

Palaeotragus expectans (Borissiak). Sarmatian, Upper Miocene; Sebastopol.

ACHTIARIA Borissiak, 1914

Synonym of *Palaeotragus*

Achtiaria expectans (Borissiak)—Generic type.

GIRAFFOKERYX Pilgrim, 1910

Giraffokeryx punjabiensis Pilgrim—Generic type. Lower and Middle Siwaliks, Lower Pliocene; India.

OKAPIA Lankester, 1901

Okapia johnstoni (Sclater)—Generic type. Recent; Africa.

SAMOTHERIUM Forsyth Major, 1888

Samotherium boisseri Forsyth Major—Generic type. Pontian, Lower Pliocene; Samos.

Samotherium neumeyeri (Rodler and Weithofer). Pontian, Lower Pliocene; Maragha, China.

Samotherium sinense (Schlosser). Pontian, Lower Pliocene; China.

Samotherium tafeli (Killgus). Lower Pliocene; China.

Samotherium eminens (Alexejew). Lower Pliocene; Odessa.

ALCICEPHALUS Rodler and Weithofer, 1890

Synonym of *Samotherium*

Alcicephalus neumeyeri Rodler and Weithofer—Generic type.

CHERSONOTHERIUM Alexejew, 1916

Synonym of *Samotherium*

Chersonotherium eminens Alexejew—Generic type.

SHANSHITHERIUM Killgus, 1922

Synonym of *Samotherium*

Shanshitherium tafeli Killgus.—Generic type.

Provisionally Placed in the Palaeotraginae

PROPALAEOMERYX Lydekker, 1883

Propalaeomeryx sivalensis Lydekker—Generic type. Lower Siwaliks (?), Lower Pliocene; India.

PROGIRAFFA Pilgrim, 1908

Progiraffa exigua Pilgrim—Generic type. Bugti beds, Lower Miocene; Sind.

Giraffinae

Large giraffids with a moderately brachycephalic skull. Horns variously developed, being located on the parietals and the frontals. In *Giraffa* a single median horn is also present, located on the nasals. Horn cores rounded or flattened on the ends, and covered with hair. Skull roof with highly developed sinus cavities.

Cheek teeth brachyodont, with heavily rugose enamel. Limbs and neck greatly elongated.

GIRAFFA Brisson, 1756

Giraffa camelopardalis (Linnaeus)—Generic type. Recent; Africa.

Giraffa sivalensis (Falconer and Cautley). Upper Siwaliks, Pleistocene; India.

Giraffa affinis (Falconer and Cautley). Synonym of *G. sivalensis*.

Giraffa punjabiensis Pilgrim. Middle Siwaliks, Pliocene; India.

Giraffa priscilla Matthew. Lower Siwaliks, Lower Pliocene; India.

Giraffa nebrascensis Matthew and Barbour. Pleistocene; Nebraska. (This genus?)

ORASIUS Oken, 1816

Orasius atticus (Gaudry and Lartet). Pontian, Lower Pliocene; Pikermi.

Orasius eximius Wagner. Synonym of *O. atticus*.

Orasius speciosus (Wagner). Synonym of *O. atticus*.

(The reader should refer to Matthew, 1929, p. 546, for a discussion of this genus. The name "*Orasius*" is used here only in a provisional way.)

HONANOTHERIUM Bohlin, 1927

Honanotherium schlosseri (Pilgrim)—Generic type. Pliocene; China.

Sivatheriinae

Gigantic giraffids, with large, heavy brachycephalic skulls. Horn cores variously developed, being of frontal and parietal origin. Skull roof with large sinus cavities.

Cheek teeth moderately hypsodont, with heavily rugose enamel. Limbs not elongated but very heavy. Body heavy.

SIVATHERIUM Falconer and Cautley, 1835

Sivatherium giganteum Falconer and Cautley—Generic type. Upper Siwaliks, Pleistocene; India.

INDRATHERIUM Pilgrim, 1910

Synonym of *Sivatherium*

Indratherium majori Pilgrim—Generic type. Upper Siwaliks, Pleistocene; India.

BRAMATHERIUM Falconer, 1845

Bramatherium perimense Falconer—Generic type. Middle Siwaliks, Pliocene; Perim Island.

HYDASPITHERIUM Lydekker, 1878

Hydaspiatherium megacephalum Lydekker—Generic type. Middle Siwaliks, Pliocene; India.

Hydaspiatherium grande Lydekker. Middle Siwaliks, Pliocene; India.

Hydaspiatherium magnum Pilgrim. Middle Siwaliks, Pliocene; India.

Hydaspiatherium birmanicum Pilgrim. Irrawaddy beds, Pliocene; Burma.

VISHNUTHERIUM Lydekker, 1876

Vishnutherium iravaticum Lydekker—Generic type. Irrawaddy beds, Pliocene; Burma.

HELLADOTHERIUM Gaudry, 1860

Helladotherium duvernoyi GAUDRY—Generic type. Pontian, Lower Pliocene; Pikermi, Samos.

Helladotherium gaudryi DE MECQUENEM. Pontian, Lower Pliocene; Maragha.

GRIQUATHERIUM Haughton, 1922

Griquatherium cingulatum Haughton—Generic type. Pleistocene; South Africa.

Of Uncertain Position

LIBYTHERIUM Pomel, 1893

Libytherium maurusium Pomel—Generic type. Pliocene; North Africa.

RELATIONSHIPS OF THE GIRAFFIDAE TO THE PROTOCERATIDAE

The Protoceratidae of North America have been linked to the Giraffidae by some authors, on the basis of certain resemblances between the members of the two groups. Schlosser, especially, would derive the Giraffidae directly from the Protoceratidae. Both Bohlin and Matthew have shown, however, that the resemblances between the Protoceratidae and the Giraffidae are due to convergence, and that these two families are really separated from each other by differences of basic importance.

There are certain resemblances in the teeth between the Protoceratidae and the more primitive Giraffidae, resemblances that may be attributed to primitive heritage characters carried over from a common Eocene ancestor. The skull resemblances, especially in the development of numerous pairs of horn cores in several genera of these two families, are due entirely to a convergence in evolutionary trends. Both the Protoceratidae and the Giraffidae produced horn cores anterior to and posterior to the orbits. But these horn cores are derived from different skull elements in the two groups. This is well illustrated by the anterior horn cores, which are of premaxillary origin in the Protoceratidae, and of frontal origin in the Giraffidae.

Dr. Matthew¹ made the following remarks with regard to the origin of the Giraffidae and the relation of this family to the North American Protoceratidae.

"The family appears to be a group of specialized survivals of the Middle Miocene Palaeomerycinae, of which *Dromomeryx*, the American genus, is the only one known from complete skulls and associated skeletons. The horns of *Dromomeryx* are of giraffoid type, long, straight, probably skin-covered, nondeciduous, supra-orbital, and with a basal

¹Matthew, W. D. 1929. Bull. Amer. Mus. Nat. Hist., LVI, p. 545.

wing that suggests the later complications in the sivatheriines. Teeth quite close to *Palaeotragus* and *Giraffokeryx*.

"Schlosser would derive giraffes from Protoceratinae, but this does not seem to be a tenable phylogeny. The protoceratines are an early specialized group of Traguloidea, with no approach to the Pecora in foot characters. The Giraffidae are true Pecora, fully developed as such in the feet, and nearly related through Palaeomerycinae to the primitive Cervidae (cf. *Eumeryx* of the Stampian Oligocene of Mongolia)."

PHYLOGENY OF THE GIRAFFIDAE

In the accompanying chart (Fig. 1), an attempt has been made to represent the phylogeny of the Giraffidae in a graphic form. On this chart the geologic distribution of the family is represented along the vertical axis, whereas the geographical extent is shown along the horizontal axis. The three subfamilies of the Giraffidae are shown by parallel shading; the Palaeotraginae being represented by vertical lines, the Giraffinae by oblique lines and the Sivatheriinae by horizontal lines. The primitive Palaeomerycidae, from which the Giraffidae might have been derived, are shown also. Certain genera, such as *Propalaeomeryx*, *Griquaetherium*, etc. are omitted from this chart.

It will be seen that the Giraffidae is a family of Miocene derivation, having its origin in the Holarctic region. It is characterized by the rapidity of evolution of its subfamilies and genera; all of the great variety of giraffid form and structure having been established since late Miocene times.

The evolutionary development of the group took place in Europe and Asia. The okapi and the giraffe, the one a persistent primitive genus and the other a genus that specialized early in the evolutionary history of the group, migrated to Africa from the Holarctic center of origin. The survival of these two forms in Africa, far from the center of origin of the family, is what might be expected. Matthew has shown, in his 'Climate and Evolution,' that persistent primitive species migrate away from the center of origin and their place is taken by more specialized forms. Or, to put it in a different way, the primitive and inadaptable species are pushed out by the specialized, adaptive species, so they must needs find refuge in peripheral regions, far distant from their place of origin.

With regard to the rapidity of evolution among the Giraffidae and the center of ultimate origin for the group, I take the liberty once more of quoting from Dr. Matthew.¹

¹Matthew, W. D. 1929. *Op. cit.*, pp. 553-555.

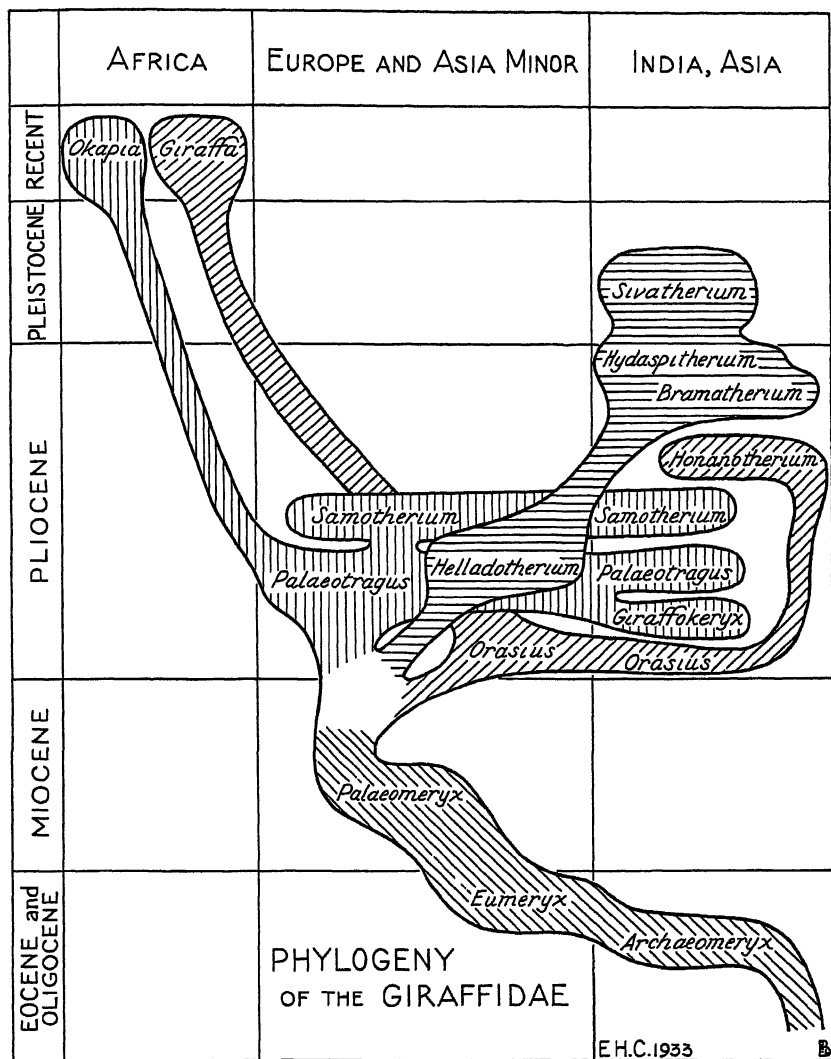


Fig. 1. The Phylogeny of the Giraffidae. The stratigraphic occurrences of the genera are represented by their vertical arrangement, and their geographic distribution is shown by their horizontal arrangement. Lines of shading represent taxonomic divisions, as follows.

GIRAFFIDAE
 Palaeotraginae
 Sivatheriinae
 Giraffinae
 PALAEOERYCIDAE

vertical lines
 horizontal lines
 oblique lines
 oblique lines

"I do not in fact think that the Giraffidae are an old family, or that any of them are very wide apart in spite of the diversity of skull structure. The lack of diversity in tooth structure is, to my mind, not due so much to the lack of change in the teeth as to the rapidity of change in the skull, and the whole family derives from late Miocene palaeomerycines, an antiquity decidedly less than most mammalian families."

"All in all, I cannot see anything more primitive in the Chinji Giraffidae than Pikermi can show, and I see no reason for hunting a separate evolution center for the giraffes in Africa when the Holarctic Miocene palaeomerycines afford a perfectly good ancestral group."

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RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 1

A NEW GENUS AND SPECIES OF SQUIRREL FROM CELEBES

By R. ARCHBOLD AND G. H. H. TATE

At least seven species of true squirrels have been recorded from Celebes: *notatus* Boddaert; *rubriventer*, *leucomus*, and *murinus*, all of Müller and Schlegel; *prevosti* Desmarest; *weberi* Jentink; and *rosenbergi* Jentink. In 1930, G. Heinrich collected the series of six "long-nosed" squirrels described in the pages following, three of which are deposited in the collections of The American Museum of Natural History. Although it was readily established that the species was new, considerable doubt arose as to its allocation generically. Descriptions of the "long-nosed" genera of squirrels of eastern Asia and the Sunda region were carefully checked and a table of measurements of the genotypes was prepared. It is to be noted, however, that adequate generic definitions for the several genera concerned are not extant, in consequence of which it was necessary to seek mainly among specific descriptions for facts of possible generic worth. The works of Major and of Frechkop on dentition, of Thomas and of Pocock on male reproductive anatomy, and of Pocock on external characters were considered. The new genus has been compared with the following: *Dremomys* (= *Zetis*),¹ with type *pernyi*; *Menetes*, with type *berdmorei*; *Lariscus*, with type *insignis*; *Tomeutes*, with type *lokroides*; and *Rhinosciurus*² with type *tupaoides*. The three last have developed numerous species and races in Malaysia and the Sunda region. In none of these genera is such an extreme elongation of the snout and claws to be observed as occurs in the

¹*Dremomys* Heude included originally the "rock-jumpers" *pernyi*, *saltitans*, *collaris*, and *latro*. In the absence of previous designation *pernyi* Milne Edwards is here proposed as type of *Dremomys*. *Zetis* Thomas with type *rufigenus* was said by its author to include also *pernyi*, *pyrrhomerus*, *lokiah*, *ercretti*, and *owstoni*.

²The status of the generic name and genotype of *Rhinosciurus* is rather obscure. Gray's (1843) name *tupaoides* was a *nomen nudum*, since it was based upon a specimen from Singapore without description (the heading "Sharp nosed Squirrel" is not to be considered a description) and had *Sciurus laticaudatus* questioningly synonymized with it. Cantor (1840) described what was possibly *tupaoides* quite fully under the name *laticaudatus* of Müller and Schlegel; and Blyth (1855), using *tupaoides*, employed certain clearly descriptive phrases as supplementing Cantor's description of the Malay animal. Finally Gray (1867) provided a short definition of his *tupaoides*. In view of the foregoing, *tupaoides* must be cited as from Blyth, 1855.

Because *tupaoides* Gray 1843 was a *nomen nudum*, *Rhinosciurus* Gray 1843 was also a *nomen nudum*. It may, however, be cited as from Blyth (1855), who used it in conjunction with his *tupaoides* in the text under his general heading "Sc. tupaoides?". A generic description appeared in Gray (1847).

Celebes form, nor does there appear in the literature any allusion to extreme lengthening of the claws among oriental squirrels. The claws depicted on the plate of *Rhinosciurus laticaudatus* are those of a normal tree squirrel. In general, too, the species of the foregoing genera are of much smaller size than the Celebes animal. Compared with the figures given by Pocock (1922) in his study of the feet of squirrels, the claws of the new form approach most nearly those of *Euxerus* and *Geoxerus* (Pocock, Fig. 53), but exceed them in length.

The general proportions of the types of the species of *Rhinosciurus*, that genus appearing most nearly allied to the Celebes genus, are shown on the table (p. 5). It will be noted that the hind foot in no case exceeds 45 mm. nor the nasals 21 mm. Data on the lengths of claws is unfortunately not available.

On the basis then of the extreme length of the nasals of old adults, the shortness of the tail,¹ the long narrow foot, and the pronounced elongation of the claws,—this last perhaps in relation to a shift from arboreal to terrestrial or even semi-fossorial habits—it has seemed advisable to set up a separate genus, which may be named *Hyosciurus*.

HYOSCIURUS,² new genus

DESCRIPTION.—A callosciurine genus of squirrel in which the nasal part of the skull reaches an extreme degree of lengthening in the adult (length of nasals exceeds length of frontals); the transverse suture between frontals and parietals forms an irregular, backwardly bowed arch, in contrast to the angular figure of that suture shown for *Rhinosciurus laticaudatus* Müller and Schlegel³; nasals and premaxillae strongly produced in front of incisors; molar series carried forward so that the lacrimal is on a level with m² instead of m¹. Angular process of mandible strongly reflected after the manner of marsupials (this character partially developed in *Callosciurus*, *Dremomys*, etc.). Hind foot not typical of the normal sturdy tree-squirrel foot, but long and slender, the width at the base of the 5th metatarsal only 7 mm. (about 14 per cent of foot length, excluding the claws). Claws very long and but little curved; those of the forefoot about 8 mm. (or 80 per cent of length of 4th digit); those of hind foot 7 mm. (nearly 60 per cent of length of 4th digit). Tail very short, from 50 to 70 per cent of length of head and body. Mammary formula not determined.

For illustrations of fore foot, skull, and teeth see figures 1 to 7.

***Hyosciurus heinrichi*, new species**

TYPE.—No. 101310, Amer. Mus. Nat. Hist.; ♂, adult; Latimodjong Mts., southern Celebes, 2300 meters; July 19, 1930; collector, G. Heinrich. Skin and skull in good condition.

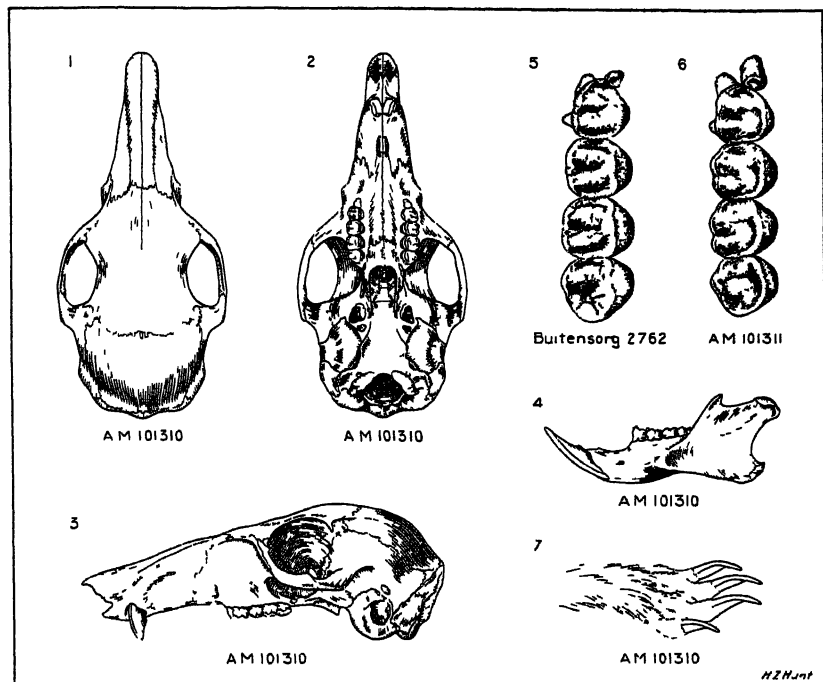
¹Note that the ratio of tail length to body length in allied genera appears to be highly variable for any one species or race.

²us, a pig; *σκίουρος*, squirrel. Heinrich employed the descriptive term "Schweineichhornchen" on his labels and in his notebook.

³1839, Bijdr. Nat. Hist., p. 100, Pl. xv, figs. 1-3.

GENERAL CHARACTERS.—A “long-nosed” ground squirrel with ears short and rounded; general color above fuscous, flecked with tawny; ventrally with an irregular median band of white about 30 mm. in width extending from mouth to belly.

DESCRIPTION.—Hairs of back not channeled, distinctly fusiform, the subterminal portion thicker than the base. Fur thick and rather soft, the dorsal hairs fuscous, with individual subterminal light tawny bands which produce the flecked effect mentioned above. Their bases are grayish white. No accessory stripes or spots. Under parts



Figs. 1 to 7. *Hyosciurus heinrichi*.

1 to 4. Views of skull of type, three-fourths natural size. 5 and 6, right upper crown views of molars, three times natural size; 5, of a young animal with unworn molars; 6, of an older specimen with teeth somewhat worn. 7, right fore foot of type, seen from outside, showing form of claws and their length in proportion to the digits, three-fourths natural size.

with longitudinal white band described above, the hairs white to the roots. Tail colored essentially as body, individual hairs about 35 mm. long. Backs of hands and feet darker than body tone. Vibrissae about 35 mm.

Skull with palate lacking a postnasal spine in type (present in other specimens). Molar series considerably longer than width of intermolar palate, parallel. Molars generally rather massive in comparison with those of *pyrrhomerus*. Tooth row shown in figures 5 and 6.

MEASUREMENTS.—See table (p. 6).

This species is founded upon the type, another male, and a younger individual whose sex is not indicated, all from Latumodjong Mts., 2300 meters, southern Celebes. A second series of three young adults (1 male, 2 females) taken also by Heinrich at Ile Ile, 1700 meters, northern Celebes, is referred to the same species.

Upon studying the table of measurements it becomes clear that full development of the rhinal portion of the skull is only attained with age. In both old and young animals the dimensions of the frontals and parietals are about alike, though the nasals of old specimens have become very much longer than those of young ones. The difference in palatal dimensions would appear to be correlated with sex, but the point requires further observation. The longer tooth rows seen in males may more probably indicate differences in sex.

Three specimens of the series will remain in the American Museum; three will be returned to the Buitensorg Museum, Java.

It is a pleasure to name this interesting species for Mr. G. Heinrich, who has secured so many important specimens of mammals from Celebes.

DIMENSIONS OF TYPES OF SPECIES AND OTHER INDIVIDUALS OF *Rhinoscirus*

	Sex and Age	Head and Body	Tail	Hind Foot	Skull: Occipito-nasal Length	Condylar Length	Basilar Length	Zygomatic Breadth	Interorbital Breadth	Nasals	Breadth Brain Case	Palatal Length	Palatine Length	Diameter	Length of Bulla	Length Upper Molar Series	Mandibular Length
<i>Rhinoscirus leo robinsoni</i>	old ♂	204	122	41 0	58 0	53 0		29 0			32 5				12 3		
	ad. ♀	199	90	37 0	53 0		43 5	25 5	12 0	18 5	20 5			15 5	10 0	11 8	
<i>peracer</i>	ad. ♀	213	122	41 0	56 0	52 0		26 6		5 3					11.7	10 0 (excl. p ¹)	
<i>leo lionis</i>	ad. ♀	212	135	42 5	59 0	55 0		28 8			32 0				12 0	10 5 (with-out p ³)	
<i>laticaudatus</i> (Miller and Schlegel)	ad. ♀ ¹	120	170		55 3	54 0		27 2		16 5	21 0			17 6	12 1		32 4
Sp (Miller, 1903)	ad. ♀	230	130	44 0	59 0 (16)		52 49	128 6	13 0	21 0	31 0			17 0		12 0 (alv.)	35 6
Sp. (Miller, 1905)	old ♂	213	65	38 5	56 0 (41)		49 16	4	13 8	20 4				16 4		11 8 (alv.)	35 0
<i>laticaudatus saturatus incultus</i>	ad. ♀	205	130	45 0	58 1	52 0		26 2	13 0	5 8	19 8			30 0	17 1	12 1	
	ad. ♀	230	130	45 0		53 8		28 3	13 4	22	23 0					12 5	

Mentink, 1883, Notes Texden Mus., V, p. 141, states the type of the species to have been an adult female. These measurements are taken from Muller and Schlegel, plate XV. They may be considered as giving proportions of the type skull of *laticaudatus*.

DIMENSIONS OF *Hyoacrius heinrichi*

	Sex and Age	Head and Body Length	Tail Length	Hind Foot (s.u.)	Skull: Occipito-nasal Length	Condylolnclnsive Length	Basal Length	Basilar Length	Zygomatic Breadth	Breadth Brain Case	Interorbital Breadth	Length Nasals	Median Suture	Length Frontal	Median Suture	Length Parietal	Palatal Length	Palatilar Length	Palatal Foramina	Diastruma	Length of Bulla	Length Upper Molar Series Excl. p ¹	Mandibular Length
Latimodjong, S. Celebes: A. M. 101310 (Buitensorg 2595)	ad. ♂ (type)	211	104	51.0	64.4	51.1	52.0	44.0	30.0	22.6	15.6	25.9 × 5.5	24.8	16.0	33.2	26.5	3	6	14.1	19.1	10.0	37.3	
(Buitensorg 2594)	old ad. ♂	238	97	51.0	66.6	53	52.5	46.4	31.1	22.8	15.9	27.3 × 6.3	24.8	17.3	33.0	27.6	3	6	15.2	28.9	10.3	37.9	
A.M. 101309 (Buitensorg 2598)	y.ad. ?	204	95	48.5	61.3	49	48.4	42.5	29.5	22.5	15.0	22.0 × 5.3	25.1	17.6	31.3	25.9	3	7	13.9	8.7	10.7	36.7	
Ile Ile, N. Celebes: A.M. 101311 (Buitensorg 2596)	y.ad. ♂	197	102	51.0	63.6	51	0	51.2	49.9	29.5	22.6	15.7 × 5.7	24.4	16.2	34.0	27.0	3	1	4	28.6	10.0	37.4	
A.M. 101388 (Buitensorg 2763)	y.ad. ♀	196	133	51.0	57.0	47.9	45.6	41.3	29.7	22.7	14.8	19.8 × 5.6	24.7	17.1	29.3	25.0	3	2	12.5	8.8	10.2	34.0	
(Buitensorg 2762)	y.ad. ♀	205	121	55.0 ¹	57.5	50.3	47.6	43.0	31.2	23.7	16.5	19.2 × 5.9	24.2	17.0	29.4	24.8	3	6	12.9	9.5	10.6	35.1	

¹Error. Should read 51.

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RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 2

TWELVE APPARENTLY NEW FORMS OF *RATTUS* FROM THE INDO-AUSTRALIAN REGION

BY G. H. H. TATE AND RICHARD ARCHBOLD

The following provisional descriptions of new forms are abstracted from a nearly completed report upon the rats of the region mentioned. The generic and group relationships assigned to species are stated arbitrarily, without presentation of the supporting evidence which will be set out fully in the principal report.

The collection containing the new species on deposit with The American Museum of Natural History comprises material assembled by (1) Archbold New Guinea Expedition; (2) Whitney South Sea Expedition; (3) collections made by Shaw Meyer, obtained by Mr. Archbold through the generosity of Dr. L. C. Sanford; (4) specimens collected by G. Heinrich in Celebes, purchased by Mr. Archbold; (5) specimens collected by G. Heinrich in Celebes, received by Mr. Archbold from Buitensorg Museum; (6) collection by J. J. Menden in Java, purchased by Mr. Archbold; and (7) collection by J. J. Menden in Sumatra, purchased by Mr. Archbold.

We wish to acknowledge our indebtedness to Dr. H. E. Anthony, American Museum of Natural History; Mr. G. S. Miller, Jr., U. S. National Museum; and Dr. W. H. Osgood, Field Museum of Natural History, for much kindly given advice and for allowing us access to the collections in their charge.

Measurements¹ are stated throughout in millimeters, altitudes in meters, and colors in terms of Ridgway.²

Rattus rattus palembang, new subspecies

TYPE.—No. 102587, Amer. Mus. Nat. Hist.; ♀, adult; Morcarah Doewa, Palembang, south Sumatra; June 3, 1934; collector, J. J. Menden. The type is a skin and skull in fair condition.

GENERAL CHARACTERS.—The south Sumatran representative of the *diardii-neglectus* subgroup of the *rattus* group.

¹Hind foot dimensions are without claws. In each case the field measurement given on the labels for hind foot has been rechecked.

²1912, 'Color Standards and Nomenclature.'

DESCRIPTION.—Color of type essentially like normal *diardii* but much warmer, approaching a warm shade of russet or hazel, especially on the shoulders and neck. Ventrally the gray-based hairs tipped with a shade between pinkish cinnamon and pinkish buff. Line of demarcation along sides imperceptible. Ears light fuscous; hands and feet with their sides buff but their dorsal surfaces gray, which color is continued on to the digits. The gray of the feet narrowed proximally by encroachment of the lateral buff color. Tail fuscous, not paler beneath.

The skull of the type differs from that of *diardii* in its slightly more massive rostrum, slightly shorter palatal foramina, narrower interparietal. Also it differs in possessing bullae with narrower inflated portion and more massive meatal portion, and in having m^1 slightly larger and wider than that of *diardii*.

MEASUREMENTS OF TYPE.—Head and body, 173 mm.; tail, 203; hind foot, 35; skull, occipitonasal length, 40.0; zygomatic breadth, 19.7; nasals, 14.0; inter-orbital breadth, 6.0; diastema, 11.1; palatilar length, 19.8; palatal foramina, 7.0; length bulla, 7.1; length molar crowns, 7.1; length crown m^1 , 3.2; width crown m^1 , 2.0.

Like *diardii*, *palembang* is somewhat variable in regard to the color of its pelage. Our series includes two individuals whose dorsal and ventral colors are somewhat less vivid than those just described for the type. The mammary formula is that for the *diardii* rats: namely, 2-3 (visible on all 9 of the females).

The race is based upon our series of 4 males and 9 females, all topotypes.

***Rattus lalolis*, new species**

TYPE.—No. 101024, Amer. Mus. Nat. Hist.; ♀, adult; Lalolis, 30 miles southeast of Mengkoka Mts., southeast Celebes, 300 meters; December 6, 1931; collector, G. Heinrich. The type is a skin in good condition and skull with sphenoidal region broken.

GENERAL CHARACTERS.—A large, thinly haired rat with cranial characters intermediate between the *hoffmanni* and *rattus* groups. Mammary formula (on 3 females, including type) 2-3. Under parts whitish in color.

DESCRIPTION.—Pelage rather thin and coarse, of mixed blackish and ochraceous tawny, the latter hairs having whitish-gray bases. Under parts buffy white, self-colored. Transition from dorsal to ventral colors gradual. Hairs on hands and feet whitish, metacarpal and metatarsal fuscous marks visible. Tail light fuscous above and below; ears small, fuscous.

Skull strongly built, with rather longer rostrum than usual for the *hoffmanni* rats; zygomatic plate well-angled; palatal openings long, pointed in front; bullae large (115 per cent of tooth row in adult type, only 100 per cent in younger specimens); teeth nearly as heavy as those of *hoffmanni*.

MEASUREMENTS OF TYPE.—Head and body, 152 mm.; tail, 215; hind foot, 40; skull, occipitonasal length, 46.5; zygomatic breadth, 21.6; nasals, 6.8×4.5; inter-orbital breadth, 6.1; diastema, 13; palatal foramina, 8.8; length bulla, 8.3; length molar crowns, 7.2; length crown m^1 , 3.2; width crown m^1 , 2.1.

The species is based upon the type from Lalolis only. But we refer five other rather young specimens (3 males, 2 females), all from Lambasang, Mt. Lampobatang, 1100 meters, to the species.

Rattus lalolis appears to be most nearly related to *hoffmanni mengkoka*. It differs from it in possessing 2-3 mammary formula; white instead of gray-based ventral hairs; and a wider hind foot (width at base of 5th metatarsal equal to 15 per cent in *lalolis*, 13-14 length of foot (s. u.) per cent in *mengkoka*).

***Rattus hoffmanni mengkoka*, new subspecies**

TYPE.—No. 101062, Amer. Mus. Nat. Hist.; ♂, adult; Wawo, Mengkoka Mts., southeast Celebes, 50 meters; January 24, 1932; collector, G. Heinrich. The type is a skin and skull in good condition.

GENERAL CHARACTERS.—The southeastern representative of *hoffmanni*, apparently extending from sea level to as high as 1500 meters on the Mengkoka Mts. Pelage of specimens from 1500 meters scarcely longer or softer than that of the type; their body size slightly less.

DESCRIPTION.—Pelage rather long, harsh and thin, the hairs as with most members of the group, fuscous, tipped with ochraceous tawny; under parts grayish white, i.e., bases gray, tips dirty white. Fine hairs of hands and feet dirty white. Tail entirely fuscous.

Skull closely approximating the measurements and drawing of *celebensis* Hoffmann,¹ but differing in possessing a narrower zygomatic plate and rather shorter tooth row.

MEASUREMENTS OF TYPE.—Head and body, 186 mm.; tail, 138; hind foot, 37.0; occipitonasal length, 44.0; back of interparietals to tip of nasals (for comparison with *h. hoffmanni*), 43.5; zygomatic breadth, 22.3; nasals, 17.0; interorbital breadth, 6.2; zygomatic plate, 5.9; diastema, 11.3; palatilar length, 21.5; palatal foramina, 8.0; length bulla, 7.3; length molar crowns, 8.0; length crown m¹, 3.8; width crown m¹, 2.4.

From higher up the Mengkoka Mountains we have the following material, also referred to the present race of *hoffmanni*: Masumbo, 550 meters, 4 males, 1 female; Tanka Salocco, 1500 meters, 1 adult male, 1 juvenal male, 2 juvenal females.

We have compared *R. h. mengkoka* with true *R. h. hoffmanni*. It remains to check it against *R. h. subditivus* of middle Celebes. That animal was described as quite large (hind foot 45 against 37 in *mengkoka*) which in our opinion sufficiently sets it off.

The single female of the series has the mammary formula 1-3=8.

¹1887, Abh. Mus. Dresden, I, No. 3, p. 18 ("M. r. *celebensis*").

***Rattus mollicomulus*, new species**

TYPE.—No. 101134, Amer. Mus. Nat. Hist.; ♀, adult; Wawa Karaing, Mt. Lampobatang, southern Celebes, 1500 meters; September 13, 1931; collector, G. Heinrich. The type is a skin in good condition and skull with brain case broken.

GENERAL CHARACTERS.—A member of the *hoffmanni* group but of quite small size, the long soft pelage indicating that it inhabits the highlands.

DESCRIPTION.—Color of the tips of the dorsal hairs of the type ochraceous tawny, paling on sides, their basal parts fuscous which shows through the tawny; ventral hairs dull white, their bases gray, a faint touch of cinnamon buff on chest; line of transition indistinct. Tail wholly fuscous. Hands and feet rather slender, the backs of the hands with a grayish shade; tops of the feet clad with whitish hairs. Ears fuscous, rather small.

Skull built after the general plan of the *hoffmanni* group, with arched upper profile, rather short muzzle, and broad molars. Zygomatic plate rather rounded along its anterior edge. Muzzle rather narrower than in some other species.

MEASUREMENTS OF TYPE.—Head and body, 153 mm.; tail, 146; hind foot, 32; zygomatic breadth, 19.0; nasals, 14.8; interorbital breadth, 5.5; zygomatic plate, 4.4; diastema, 10.9; palatilar length, 18.5; palatal foramina, 7.4; length bulla, 6.3; upper molar crowns, 6.6; length crown m¹, 2.9; width crown m¹, 2.1.

We base the species upon the type, together with another adult male and a juvenal (both topotypes). In addition we refer to the species Nos. 2597 and 2599 of the Buitensorg Museum (both adult males), which have slightly larger bullae.

This long-furred mountain form is to be compared only with *linduensis* and *mollicomus*. Both are larger rats. *Linduensis* is described as "smaller and darker" than *hoffmanni*.

The mammary formula is apparently 1-3=8.

***Rattus brachyrhinus*, new species**

TYPE.—No. 104210, Amer. Mus. Nat. Hist.; ♂, adult; Baroka, near mouth of Angabunga (=St. Joseph's) River, Central Division, Papua; 30 meters; April 8, 1933; collectors, Archbold and Rand. The type is a skin and skull in good condition.

GENERAL CHARACTERS.—A *norvegicus*-like *Rattus* (but smaller), member of the *tunneyi* group, with only slightly coarsened pelage mixed with a few long guard hairs. Skull known by its large bulla, narrow interorbital region, long narrow palatal foramina. (Also, in females, mammary formula 3-3=12.)

DESCRIPTION.—Pelage dorsally somewhat coarse and slightly crisp, the hairs basally fuscous with the terminal fourth clay color, a small proportion entirely fuscous, and a scattering of very long fuscous guard hairs. Ventrally the hair color between dark olive-buff and deep olive-buff, all hairs having gray bases. The region about chin and lips paler and whiter. Tail short, uniformly fuscous, the scales roughly squarish, the median scale-hairs about two scale lengths, the lateral ones, one and one-half scale lengths. Feet and hands pale clay color.

Skull characterized by its generally arched form, wide brain case and strongly narrowed interorbital region; proportionately (to *norvegicus*) narrowed, elongated

interparietal bone; short nasals, their anterior tips not exceeding the premaxillae; long, narrow, slitlike palatal openings which reach backward to a level with the back of the first lamina of m^1 ; narrowed interdental palate; narrowed interpterygoid fossa; large inflated bullae whose length exceeds both crown and alveolar lengths of the molar series; anterior part of zygomatic plate thrown well forward and clearly visible from above. The molars are *Rattus*-like.

MEASUREMENTS OF TYPE.—Head and body, 187 mm.; tail, 141; hind foot, 31.0; skull, occipitonasal length, 39.3; basal length, 36.0; zygomatic breadth, 20.0; interorbital breadth, 4.9; nasals, 1.42×4.7 ; breadth brain case, 14.9; zygomatic plate, 4.1; diastema, 10.9; palatilar length, 18.4; palatal foramina, 7.9; length bulla, 8.2; upper molar crowns, 6.8.

Brachyrhinus is founded on the type and a series of six other males and one female from Baroka; also a complete skeleton (A.M. No. 104373, ♂). The paratypes all bear the slightly yellowish ventral color that has been described above as olive buff.

A series of 3 males and 2 females of the same species from the Loloki River, 20 miles east of Port Moresby, differs slightly in that the dorsal pelage is rather finer and darker and the ventral pelage is whiter, though almost entirely gray-based.

A third set of rats of the same species, 14 males and 6 females, was taken at the Oriomo River, near the mouth of the Fly River. These closely match the type series in dorsal color, though ventrally, like the set from Loloki River, they are slightly paler. The texture of their fur is like true *brachyrhinus*.

This species of rats is so distinct from the *ringens*, *rattus*, and *norvegicus* types and yet appears to be so abundant that one wonders how it can have remained undescribed. Indeed, it may yet turn out to be identical with *ratticolor* or still more probably with some species of Queensland, north Australia.

The mammary formula $3-3=12$ is interesting and rare. It occurs in *norvegicus*, *jalorensis*, *dammermanni*, and *pesticulus*, but not in true *rattus* so far as we have observed. The full number of mammae can be noted in a number of the females.

It can be inferred from the character of the three localities where Archbold trapped it that the species is an inhabitant of the drier coastal lowlands, probably of wide distribution where suitable habitats occur. The altitudes of the three localities are 30 meters (Baroka), 450–600 meters (Loloki), and 50 meters (Oriomo).

A specimen in the U. S. National Museum from north Queensland is the only member of the *tunnnneyi* group in Australia that we know of with gray-based ventral pelage. It is larger than *brachyrhinus*.

***Rattus penitus inferior*, new subspecies**

TYPE.—No. 101059, Amer. Mus. Nat. Hist.; ♂, adult; Wawo, Mengkoka Mts., southeastern Celebes, 50 meters; January 23, 1932; collector, G. Heinrich. The type is a skin and skull in fair condition.

GENERAL CHARACTERS.—A large member of the *chrysocomus* group with coarser pelage than either *penitus penitus* or *penitus sericalus*. Under parts irregularly suffused with hazel. Skull massive for the group, with long, broad palatal foramina.

DESCRIPTION.—Pelage of type with guard hairs distinct, though not longer than wool hairs; color of tips of hairs dull fawn color, the gray bases showing through and dulling the total effect. Under parts with fur mostly gray-based, tips whitish on throat, a little on sides and inside of limbs, otherwise tips hazel. Line of demarcation not sharp. Tail white beneath, not white-tipped.

Skull of type with large muzzle and sloping zygomatic plate. Length of palatal foramina exceeding length of molar crowns (118 per cent), which in turn exceeds length of bulla (110 per cent). The molar series, though short, is made up of rather heavy individual teeth (width of m^1 is 62 per cent of its length).

MEASUREMENTS OF TYPE.—Head and body, 177 mm.; tail, 170; hind foot, 40.5; skull, occipitonasal length, 45.3; zygomatic breadth, 20.5; nasals, 18.8; interorbital breadth, 6.6; breadth brain case, 16.8; diastema, 12.2; palatilar length, 20.8; palatal foramina, 9.3; length bulla, 6.9; length molar crowns, 7.8; length crown m^1 , 4.0; width crown m^1 , 2.5.

This new race is based upon three adult males besides the type, the youngest of which shows the ventral suffusion of hazel only in slight degree. To the same race we have referred three males and two females from Masumbo, 550 meters, on the same range of mountains.

***Rattus penitus heinrichi*, new subspecies**

TYPE.—No. 101006, Amer. Mus. Nat. Hist.; ♂, adult; Lambasang, Mt. Lampohatang, southern Celebes, 1100 meters; August 31, 1931; collector, G. Heinrich. The type is a skin in good condition, but the skull somewhat broken by the trap.

GENERAL CHARACTERS.—A medium-sized member of the *chrysocomus* group with dense though rather crisp pelage.

DESCRIPTION.—Pelage of type coarser than that of *R. p. penitus* or *R. p. sericalus*, and much denser than *R. p. inferior*. Color above, rather strong sayal brown at tips of hairs, giving a general effect of natal brown due to dark-colored hair bases showing through from below. Under parts long-haired, the hairs between pinkish buff and cream buff, with gray bases. Hands and feet thinly clothed with whitish hairs. Tail whitish beneath, the scale-hairs about one and one-half scale lengths.

Skull of type more delicately formed than that of *p. inferior*, with narrower rostrum (? constant), smaller palatal foramina, shorter bullae, narrower mesopterygoid fossa.

MEASUREMENTS OF TYPE.—Head and body, 162 mm.; tail, 136; hind foot, 35.0; skull, occipitonasal length, 40.0; zygomatic breadth, 19.9; nasals, 15.5; interorbital breadth, 6.3; breadth brain case, 16.4; diastema, 10.5; palatilar length, 18.3;

palatal foramina, 7.6; length bulla, 6.4; length molar crowns, 7.3; length crown m^1 , 3.7; width crown m^1 , 2.3.

R. p. heinrichi is founded on a topotypical series of thirteen males, six females and two rats of unascertained sex. A number of individuals are somewhat young.

It is a pleasure to name this fine variety for its collector, G. Heinrich.

***Rattus brevimolaris*, new species**

TYPE.—No. 101055, Amer. Mus. Nat. Hist.; ♂, adult; Lalolis, 30 miles southeast of Mengkoka Mts., southeastern Celebes, 300 meters; February 15, 1932; collector, G. Heinrich. The type is a skin and skull in fair condition.

GENERAL CHARACTERS.—A rather small member of the *chrysocomus* group with somewhat thin pelage, possessing a skull with small palatal foramina, narrowly pointed anteriorly and quite small molars.

DESCRIPTION. Pelage of type rather thin, thinner than that of *andrewsi*, approximating the condition in the larger sized *inferior*. Dorsal color, as in allied forms, near natal brown, but not uniformly so because of dulling effect of gray under-color. Ventral color dirty buff, becoming clay color on breast and russet just anterior to scrotum. No clear line of demarcation along sides. Feet dull grayish-white. Tail short, white beneath.

Skull small and delicate, the palatal foramina well pointed in front, only slightly exceeding length of tooth row (110 per cent); bulla large to medium (in type 7.0 mm., in another specimen, female, only 6.1 mm.). Molars quite small.

MEASUREMENTS OF TYPE.—Head and body, 157 mm.; tail, 138; hind foot, 34.0; skull, occipitonasal length, 39.6; zygomatic breadth, 19.0; nasals, 15.4; interorbital breadth, 6.5; breadth brain case, 16.0; diastema, 10.9; palatilar length, 17.7; palatal foramina, 6.8; length bulla, 7.0; length upper molar crowns, 6.2; length crown m^1 , 2.9; width crown m^1 , 1.9.

Besides the type, 3 males and 3 females, all topotypes have been studied. At first sight this species looks like *andrewsi*. The latter, however, has crown of m^1 at least 3.8×2.2 . When the type of *chrysocomus* is restudied it may be found that our *brevimolaris* will fit in with it. Meanwhile, we consider the closest allies of *brevimolaris* to be *nigellus* and *rallus*.

***Rattus salocco*, new species**

TYPE. No. 101119, Amer. Mus. Nat. Hist.; ♀, adult; Tanka Salocco, Mengkoka Range, southeastern Celebes; 1500 meters; January 6, 1932; collector, G. Heinrich. The type is a skin and skull in good condition.

GENERAL CHARACTERS.—A large *xanthurus* rat with buffy white under parts, proportionately short hind feet, a short-muzzled skull with large bullae, wide molars and narrow zygomatic plate.

DESCRIPTION.—Dorsal pelage of brown-tipped fuscous hairs with an admixture of long fuscous guard hairs as in *xanthurus* and *marmosurus*, though not so long. Ventral pelage self-colored, buffy white becoming strongly yellowish on under neck.

Transition from dorsal to ventral coloration indistinct. Ears small, about as in *xanthrus*. Feet and hands with dark metatarsal mark, thinly white-haired, the fingers and toes white. Tail with distal two-thirds white, the hairs attaining about two scale-lengths, terminally four scale-lengths.

Mammæ 2-2=8.

Skull with broad, heavy muzzle, rather narrow brain case, temporal ridges heavy, interparietal large (6×12.5). Incisors moderately heavy; molars broad and short; palatal foramina just level with anterior roots of m^1 - m^1 , 41 per cent of palatilar length; bullae very large, 124 per cent of length of molar crowns.

MEASUREMENTS OF TYPE.—Head and body, 211 mm.; tail, 265; hind foot 39.0; skull, occipitonasal length, 46.0; zygomatic breadth, 23.5; nasals, 16.7; interorbital breadth, 6.2; zygomatic plate, 4.3; diastema, 13.2; palatilar length, 22.0; palatal foramina, 9.0; length bulla, 9.5; length molar crowns, 7.7; length crown m^1 , 3.5; width crown m^1 , 2.5.

The present species is based upon the type and a paratype (♀). Both exhibit the mammary formula 2-2=8 perfectly distinctly. The shortness of the hind foot, almost as short as basilar length of skull, is noteworthy.

Rattus microbullatus, new species

TYPE.—No. 101108, Amer. Mus. Nat. Hist.; ♂, adult; Tanka Salocco, Mengkoka Range, southeastern Celebes; 1500 meters; January 4, 1932; collector, G. Heinrich. The type is a skin and skull in good condition.

GENERAL CHARACTERS.—A member of the *xanthrus* group with dark pelage lacking much of the brownish shade of *salocco*, with under parts entirely gray-based, as in *taerae*, and skull with broad molars, short palatal openings and very small bullae (for the group).

DESCRIPTION.—General color dark gray sprinkled with ashy white, a slight tint of brownish appearing in the hair tips of the flanks. Guard hairs few, almost as short as general pelage. Ears in proportion the same as those of *dominator*. Face almost pure fuscous; vibrissae black. Under parts with hairs buffy tipped, their bases fuscous. Line of transition indistinct. Hands and feet, including toes, brownish fuscous. Basal half of tail fuscous, distal half whitish. Tail hairs only one scale length, at tip one and one-half to two scale lengths.

Skull with heavy rostrum, nasals backwardly pointed as in *dominator*; brain case rather full and broad; temporal ridges only moderately enlarged; interparietal small (4.5×9.5). Incisors wide and heavy, somewhat opisthodont; molars large and wide; palatal foramina only 30 per cent of palatilar length; and, further, bulla very reduced, only 95 per cent of length of palatal foramina.

MEASUREMENTS OF TYPE.—Head and body, 203 mm.; tail, 223; hind foot, 42.0; skull, occipitonasal length, 50.4; zygomatic breadth, 25.2; nasals, 19.8; interorbital breadth, 6.7; zygomatic plate, 5.3; diastema, 14.0; palatilar length, 23.3; palatal foramina, 7.0; length bulla, 6.6; length molar crowns, 9.0; length crown m^1 , 4.1; breadth crown m^1 , 2.9.

This species is based upon the type (♂) and a paratype (adult ♀), the mammary formula of which apparently is 1-2=6 (normal for the

group). There is also a juvenal female in poor condition. In that animal the general dark color of the pelage is intensified, and though all three molars are erupted, wear appears as far forward as the last lamina of m^1 only.

***Rattus arcuatus*, new species**

TYPE.—No. 101111, Amer. Mus. Nat. Hist.; ♀, adult; Tanka Salocco, Mengkoka Range, southeastern Celebes, 1500 meters; January 11, 1932; collector, G. Heinrich. The type is a skin and skull in good condition.

GENERAL CHARACTERS.—A *xanthurus* rat generally resembling *taerae* and *microbullatus* in exterior appearance and in its gray-based ventral fur, but differing in the strongly arched nature of the skull and long, slender muzzle.

DESCRIPTION.—Dark fuscous dorsal hairs flecked with grayish, a number of the hairs being black throughout (short guard hairs, probably); a lighter brownish-gray shade on sides and thighs; face much as body; a spot of white (individual) on the frons. Ventrally the hairs fuscous, with grayish white tips. Ears large as in *dominator*. Hands and feet with whitish hairs (not black as in *microbullatus*). Distal half of tail white. Tail hairs attaining one scale length, in both mesial and terminal parts of tail.

Skull slender, the muzzle long and slender; temporal ridges rather weak, lightly beaded; interparietal small (4×10); skull strongly arched or flexed at the level of the frontal-nasal suture. Zygomatic plate moderately broad, its anterior margin well in advance (about 3 mm.) of the notch; incisors narrow (each about 1.3 mm. across); palatal foramina quite narrow and slitlike, rather short (31–32 per cent of palatilar length); molars rather heavy; bulla fairly short, subequal in length to that of palatal foramina and only 76 per cent of length of molar series (crowns).

MEASUREMENTS OF TYPE.—Head and body, 203 mm.; tail, 245; hind foot, 43.5; skull, occipitonasal length, 50.0; zygomatic breadth, 21.7; nasals, 20.7; interorbital breadth, 6.7; zygomatic plate, 5.7; diastema, 12.5; palatilar length, 21.9; palatal foramina, 7.8; length bulla, 7.0; upper molar crowns, 9.3; length crown m^1 , 4.7; width crown m^1 , 2.6.

Arcuatus is founded upon a series of 3 males and 3 females, in addition to the type, all topotypical.

Pectoral mammae can be found in none of the four females, although two pairs of inguinal mammae are readily discerned, so we conclude that the formula for the species is $0-2=4$.

***Rattus aspinatus*, new species**

TYPE.—No. 101281, Amer. Mus. Nat. Hist.; ♀, quite young adult; Ile-Ile, northern Celebes; December 4, 1930; collector, G. Heinrich. The type is a skin and skull, the latter badly broken.

GENERAL CHARACTERS.—A member of the *whiteheadi* group of rats, namely, with tail shorter than body, with very small bullae and very short palatal foramina, and normally with spinous pelage. The pelage of the new form, however, is entirely spineless.

DESCRIPTION.—Color above very dark, fuscous, the extreme tips of the hairs near Mars brown; beneath, the hairs gray-based, with their tips dull buffy gray; the sides

have the hairs tipped with clay color, making the transition from dorsal to ventral color indistinct. Backs of hands and feet dark gray; fingers and toes flesh-colored. Ears quite small, fuscous. Tail fuscous above, pale below, the true colors marred by heavy applications of a preservative which makes them appear silvery white. Feet formed as in the *whiteheadi* group.

Skull of type with whole of occipital portion broken. Rostrum short, rather narrow; zygomatic plate narrow, its anterior edge nearly upright; anteorbital notch, seen from above, shallow; palatal foramina and bullae very short; back of palate level with back of m^2 ; teeth as in *whiteheadi*.

MEASUREMENTS OF TYPE.—Head and body, 98 mm.; tail, 93; hind foot, 26.5; skull, zygomatic breadth, 14+; interorbital breadth, 5.5; nasals, 9.1; interparietal, 3.9×8.4; zygomatic plate, 2.1; diastema, 6.5; palatilar length, 11.4; palatal foramina, 3.7×2; length bulla, 3.9; length molar crowns, 6.0; length crown m^1 , 3.1; width crown m^1 , 1.9.

The type and a single paratype (A.M. No. 101282, young ♂), differing in no way from the former, form the basis for differentiation of this apparently distinct species. We believe that these rats form the first record of any member of the *whiteheadi* group in Celebes.

Doubtless it will be found that adults of *aspinatus* will present a far less melanistic appearance than do the two young specimens before us. No skull has been found for the male paratype.

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RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 3

TWELVE APPARENTLY NEW FORMS OF MURIDAE (OTHER THAN *RATTUS*) FROM THE INDO-AUSTRALIAN REGION

BY G. H. H. TATE AND RICHARD ARCHBOLD

As explained in a previous article¹ in which new forms of *Rattus* were described, the new species proposed in the following pages are included in a series of collections brought together by Mr. Richard Archbold and deposited at The American Museum of Natural History, New York.

***Bunomys caelestis koka*, new subspecies**

TYPE.—No. 101236, Amer. Mus. Nat. Hist.; ♀, adult; Tanka Salocco, Mengkoka Mts., southeastern Celebes, 1500 meters; January 11, 1932; collector, G. Heinrich. The type is a skin and skull in good condition. (Female selected for comparison with type of *B. c. caelestis*.)

GENERAL CHARACTERS.—Smaller than true *caelestis* and with smaller hind foot, shorter claws, and shorter nasal bones.

DESCRIPTION.—Pelage soft and fine, dorsally fuscous-based, tipped with Mars brown which pales to Prout's brown on sides. Under parts with bases of hairs fuscous, their tips tawny, the tawny becoming pale russet on chest and throat. Hands and feet with backs light fuscous, digits flesh-colored. Tail fuscous above, flesh-colored beneath. Ears light fuscous. Claws, though decidedly more elongate than those of the *R. chrysocomus* rats (of which we consider *Bunomys* a derivative), shorter than those of *B. c. caelestis*.

Skull with the long rostrum and full occipital region of *Bunomys*. Zygomatic plate sloping; palatal foramina short; bullae moderate in length; back of palate level with back of m^3 ; molar teeth small. No inflation of muzzle (which, however, probably occurs as a manifestation of age and growth).

MEASUREMENTS OF TYPE.—Head and body, 135 mm.; tail, 148; hind foot, 33.5; length claw digit 3 of forefoot, 3.8; skull, occipitonasal length, 38.7; zygomatic breadth, 18.1; interorbital breadth, 6.6; breadth of brain case, 15.3×3.9 ; nasals, 15.4×4.0 ; interparietal, 5.1×9.9 ; zygomatic plate, 2.8; diastema, 10.7; palatilar length, 17.5; palatal foramina, 6.3×2.4 ; length bulla, 6.8; upper molar crown length, 6.1; length crown m^1 , 2.9; width crown m^1 , 2.0.

***Melomys tafa*, new species**

TYPE.—No. 104341, Amer. Mus. Nat. Hist.; ♀, adult; Mount Tafa, 30 miles southwest of Mt. Albert Edward, Papua, 2400 meters; September 2, 1933; collector, Richard Archbold. The type is a skin and skull in good condition.

¹1935, Amer. Mus. Novitates, No. 802.

GENERAL CHARACTERS.—A medium-sized *Melomys* of that division of the genus with one scale-hair per tail scale, with upper parts gray with a brownish cast, not fulvous however; and under parts whitish, the hairs all gray-based. Tail paler beneath.

DESCRIPTION.—Pelage long and very soft, about 10 mm. on the back. General dorsal color bone brown, paling to natal brown or Hay's brown on sides and rump. Under parts grayish white with bases of all hairs gray. Hands and feet whitish buff. Tail fuscous, beneath flesh-color. Tail slightly longer than body. Feet slender.

Skull delicate, well rounded; muzzle moderately lengthened; interorbital region not much narrowed; neither maxillary nor squamosal root of zygoma flaring abruptly; temporal ridges very slight, rather more developed in some paratypes; palatal foramina moderate in length.

MEASUREMENTS OF TYPE.—Head and body, 128 mm.; tail, 143; hind foot, 30.3; skull, occipitonasal length, 34.7; zygomatic breadth, 17.1; breadth brain case, 13.4; nasals, 12.0×4.1; zygomatic plate, 3.8; diastema, 9.7; palatilar length, 16.1; palatal foramina, 4.7; length bulla, 4.3; upper molar crowns, 6.7; length crown m¹, 3.3; width crown m¹, 1.9.

This new species, which appears to be closest to *rubex*, is based upon four males and five females (including the type). A male from Murray Pass is referred also to *tafa*. At Mt. Tafa the habitat of this species seems to be identical with that of the larger *mollis*.

***Melomys shawi*, new species**

In the Shaw Mayer collection from the Weyland Range is a specimen A.M. No. 101959 (field No. 93) which Dollman¹ identified as *Melomys platyops*. This animal, which agrees rather closely in general structure with our new species *tafa* and with Thomas's description of *rubex*, is certainly not referable to *platyops* (compare dimensions). The tail possesses the one hair per scale arrangement. The feet are slender and moderately long, but the dorsal color is fulvous, with an admixture of blackish medially. Ventrally the whitish hairs are all gray-based. The animal seems to have no counterpart among described species.

TYPE.—No. 101959, Amer. Mus. Nat. Hist.; ♂, adult; Weyland Range, Dutch New Guinea; 1200 meters; July 10, 1930; collector, F. Shaw Mayer. The type is a skin and skull in good condition.

GENERAL CHARACTERS.—A small-sized *Melomys* colored deep mahogany on back, under parts of gray-based white hairs. Feet slender. Tail fuscous above, paler beneath. Related most nearly to *rubex* and *tafa*.

DESCRIPTION.—Pelage 11 mm. on back. Color warm sepia (Ridgway), heavily irrorated with blackish, paling on sides to snuff brown. Ventral pelage 6 mm., color as indicated above. Line of demarcation sharp. Face somewhat grayer than back. Feet buffy.

¹Rothschild and Dollman, 1933, Proc. Zool. Soc. London, p. 214.

Skull closely resembling that of *Iafa*, the muzzle somewhat slenderer but general dimensions almost identical.

MEASUREMENTS OF TYPE.—Head and body, 110 mm.; tail, 109; hind foot, 27; skull, occipitonasal length, 32.9; zygomatic breadth, 16.4; interorbital breadth, 5.7; breadth brain case, 13.4; nasals, 11.5×3.5 ; diastema, 9.0; zygomatic plate, 3.7; palatilar length, 15.0; palatal foramina, 4.4; length bulla, 3.9; upper molar crowns, 6.4; length crown m^1 , 3.2; breadth crown m^1 , 1.9.

This form is very readily distinguished from *platyops* by its subequal body/tail proportions, small size, shorter molar series, and shallower mandible.

***Melomys latipes*, new species**

TYPE.—No. 104273, Amer. Mus. Nat. Hist.; ♂, young adult (the teeth only moderately worn); Baroka, Meko District, Central District, Papua, nearly sea level; April 11, 1933; collector, R. Archbold; No. 1343. Skin in good condition; skull with left maxillary portion broken.

GENERAL CHARACTERS.—A dark-colored, broad-footed *Melomys* with tail wholly fuscous; its scales with but one hair each; and its under parts white, the hairs of the median area from chin to vent white to the roots.

DESCRIPTION. Dorsal pelage generally short (8–9 mm.) and rather crisp, colored nearest to bone brown, becoming paler on sides by admixture of snuff brown. Under parts with belly fur about 4 mm., general color white, the median area for a width of about 13 mm. with the bases of the hairs white, but this extended on throat and chin to 15 mm. White area bordered by the snuff-brown hairs of the sides, all of which have gray bases. Arms and legs snuff-brown to clay. Hands and feet darker. Tail wholly fuscous. Ears fuscous. Feet broad and strong.

Skull rather strongly built; nasals not elongate; interorbital region moderately broad, the temporal edges sharp but scarcely beaded, diverging posteriorly along the parietosquamosal suture. Widest part of zygoma at squamosal. Anterior palatal foramina rather long, as in *mollis*. Teeth strong and somewhat broadened. Bullae, though small, broad and well rounded.

MEASUREMENTS OF TYPE. Head and body, 142 mm.; tail, 147; hind foot, 31; breadth of hind foot at level of proximal end of 5th metatarsal, 4.9; skull, condylo-incisive length, 32.1; zygomatic breadth, 17.5; interorbital breadth, 5.6; breadth brain case, 14.5; diastema, 9.1; zygomatic plate, 4.0; palatilar length, 15.6; palatal foramina, 4.9+; length bulla, 4.4; length molar crowns, 7.1; length crown m^1 , 3.1; width crown m^1 , 2.0.

M. laticeps agrees with none of the described species of *Melomys* even approximately, so even though it is undesirable to set up a new species based upon one complete specimen only, in this case it seems necessary.

***Melomys sevia*, new species**

TYPE.—No. 79755, Amer. Mus. Nat. Hist.; ♂, adult; Sevia, Cromwell Range, Huon Peninsula, Mandated Territory of New Guinea; 1400 meters; March 14, 1929; collector, R. H. Beck, Whitney South Sea Expedition. The type is a skin and skull in fair condition (skull broken at back; skin measured only roughly in inches in the field).

GENERAL CHARACTERS.—A rather small species with long lux reddish-brown dorsal pelage, and ventral fur grayish white, all gray-based. The tail fuscous above and below, its scale-hairs three per scale and in length about two scale-lengths, in this respect approaching *moncktoni*. The animal, however, is far smaller.

DESCRIPTION.—Color nearest to natal brown, paling to sayal brown on sides and rump. The face and forehead, as in *moncktoni*, lightly washed with grayish. Hands and feet buffy white. Vibrissae long, reaching 47 mm.

Skull with wide brain case unbeaded, square supraorbital edges, and almost no abrupt spring of squamosal roots of zygomatics. Rostrum moderately shortened; the frontal area with marked depression (possibly abnormal). Palate rather narrow, with rather long foramina for *Melomys*. Median pterygoid fossa also narrow for the genus. Bulla of the customary small size. Molars normal for *Melomys*. Anterior edge of zygomatic plate almost straight up and down, not projecting forward.

MEASUREMENTS OF TYPE.—Head and body, 124 mm.; tail, 140; hind foot, 25; skull, occipitonasal length, 31.5; zygomatic breadth, 15.3; interorbital breadth, 5.2; breadth brain case, 13.4; nasals, 10.0×3.2 ; diastema, 7.6; zygomatic plate, 3.3; palatal length, 13.0 palatal foramina, 5.1, upper molar crowns, 5.7; length crown m^1 , 2.5; width crown m^1 , 1.6.

This animal (the type is the only specimen known to us) does not agree with the published description of any species, though apart from the quite considerable difference in size it probably comes nearest to *moncktoni*. From the quality of its fur it is readily recognized as a mountain-living species. Indeed, superficially it is quite like the animal which we have called *ruber*, but from that form it differs in lacking the russet wash over the belly hairs, in the important scale-hair arrangement, and in certain skull characters.

***Uromys neobritannicus*, new species**

TYPE.—No. 99881, Amer. Mus. Nat. Hist.; ♂, adult; New Britain, Solomon Islands, 1933; collector, W. J. Eyerdam, Whitney South Sea Expedition. The type is a skull in good condition without a skin.

GENERAL CHARACTERS.—An aberrant member of the *anak* group of *Uromys*, differing conspicuously through its remarkably developed postorbital processes, by reason of which it is totally unlike any *Uromys* hitherto described. It is open to question whether this skull may not be worthy of subgeneric separation from *Uromys*, for *Cyromys* was differentiated on the basis of characters of about equal weight.

DESCRIPTION.—The skull of a very large *Uromys*, with condyloincisive length of 66 mm., and length of molar series 13.9, thus comparable only with *Uromys anak*. The dorsal surface of the skull presents special characters of major importance, constituted by the remarkable triangular postorbital prominences whose tips are 27 mm. apart. Those processes must bring about secondary adjustments of the temporal muscles and ridges in response to their development. The processes are situated entirely on the squamosal bones, and their presence, though at a lower level within the temporal fossa and covered by temporal muscle, is clearly to be seen in Frechkop's rough drawings of several giant rat genera. It may also be noted in incipient

¹1932, Frechkop, Bull. Mus. Roy. d'Hist. Nat. Belgique, VIII, No. 28, p. 8.

form in most species of *Uromys*. In *neobritannicus* the dorsal surface of the process instead of being covered by muscle attachment makes contact with the dermis of the head and thus separates the anterior part of the origin of the temporal muscle completely into two parts. The temporal ridges curve backward and medially from the processes, approaching one another most closely at the level of the front edge of the interparietal, and then turn outward to lose themselves in the lambdoidal crest. The mandible is very deep from articular process to the back of the angular process (23.7). In *anak* (♀, however) it is only 19.2. The coronoid process is short and blunt.

MEASUREMENTS OF SKULL OF TYPE.—Occipitonasal length, 67.6 mm.; zygomatic breadth, 36.8; breadth brain case, 23.4; interparietal, 7.6×14.2 ; interorbital breadth, 11.2; nasals, 24.0×6.7 ; diastema, 20.4; zygomatic plate, 10.4; palatilar length, 34.8; palatal foramina, 7.0; length of bulla, 6.4; upper molar crowns, 13.9; length crown m^1 , 6.7; width crown m^1 , 3.8.

Uromys meyeri lampo, new subspecies

TYPE.—No. 101128, Amer. Mus. Nat. Hist.; ♀, adult; Wawa Karaing, Mt. Lampobatang, southern Celebes; 2200 meters; September 13, 1931; collector, G. Heinrich. The type is a skin (overstuffed) and skull in good condition.

GENERAL CHARACTERS. A large grayish rat with hairs tipped with whitish and under parts buffy white, the terminal half or three-fifths of tail flesh-colored. Almost indistinguishable externally from *meyeri* and *longicaudatus*.

DESCRIPTION.—Pelage rather woolly, the guard hairs, though longer, only slightly heavier than the wool hairs. General color of head and back fuscous to chaetura drab, flecked with whitish; slightly darker toward the median line than at sides. Head colored as body. Under parts buffy white, all hairs being gray at the base. Dorsal color gradually passing into ventral color. Proportion of white terminal part to gray basal part of hairs greater on throat, chest and abdomen. Feet and hands with hairs gray brown, tipped with white. A slightly darker patch extending from the ankle almost to the end of the fourth and fifth metatarsals. Hairs subtending the claws white. Tail with distal half whitish flesh-colored, about equal in length to head and body.

Skull closely similar in general characters to that of *longicaudatus* and to the drawing by Hoffmann of that of *meyeri*. It can be distinguished from the former by its much longer palatal foramina, longer bullae, and narrower nasals more arched over the nares, and by possessing longer tooth rows. From *meyeri* it may be separated only by its long palatal openings.

The dentition of the new form differs slightly from that of *longicaudatus* in that the third loph of m^1 and m^2 each possess an internal enamel loop, almost excluding the posterior-projecting process of the internal tubercle of their respective second loph from the inner side of the tooth. That there exists considerable variation in the folding of the enamel in this species is shown by A.M. No. 101125, in which an accessory lamellate fold is given off from the back of the median tubercle of the third loph of both m^1 and m^2 toward the external side of the tooth. The teeth of *meyeri* drawn by Hoffmann appear closest to those of *longicaudatus*. They lack the extra lamellae described above.

MEASUREMENTS OF TYPE.—Head and body, 275 mm.; tail, 276; hind foot, 45; occipitonasal length, 57.1; zygomatic breadth, 28.3; nasals, 20.5×5.9 ; interorbital

breadth, 7.3; interparietal, 5.3×9.3 ; diastema, 15.8; zygomatic plate, 6.0; palatilar length, 27.7; palatal foramina, 8.8; length bulla, 8.8; upper molars crowns, 11.0; length crown m^1 , 4.7; width crown m^1 , 3.2.

Besides the type, *L. m. lampo* is based upon two male and three female paratypes, all from the type locality. We believe that the skull from Paré-Paré figured by Jentink¹ should also be referred to *meyeri lampo*.

Individuals of the series vary only slightly in color-tone from one another. One has a tuft of white hairs on the crown of the head, another has the under parts more strongly tinged with yellowish than has the type.

***Pogonomys lepidus huon*, new subspecies**

TYPE.—No. 79763, Amer. Mus. Nat. Hist.; ♂, Sevia, Cromwell Mt., Huon Peninsula, New Guinea; March 20, 1929; collector, R. H. Beck, Whitney South Sea Expedition. The type is a skin and skull in fair condition (both jugals missing).

GENERAL CHARACTER.—A rufous-backed, white-bellied (white to bases of hairs) *Pogonomys* closely allied to *lepidus lepidus*.

DESCRIPTION.—General dorsal color close to snuff brown, slightly darker along the back, paler and clearer on face and sides. Under parts pure white, the hairs white to the bases. Ears brown, naked; hands and feet clothed with fine white hairs. Tail rather dark brown, but little paler beneath.

Skull with the short rostrum, flaring zygomata, and complex teeth of the genus.

MEASUREMENTS OF THE TYPE.—Head and body, 135 mm.; tail, 185; (the two foregoing, which are taken from the dried skin, are probably excessive); hind foot, 22; skull, occipitonasal length, 30.2; basal length, 26.7; zygomatic breadth, 16.4; inter-orbital width, 4.4; nasals, 10.4×2.9 ; zygomatic plate, 3.3; palatal length, 15.4; palatilar length, 13.5; palatal foramina, 3.9×1.9 ; length bulla, 4.2; upper molar crowns, 5.2; length crown m^1 , 2.4; width crown m^1 , 1.8.

The new form differs from true *lepidus* in its somewhat larger size, larger teeth and longer toothrow, and especially in its shorter palatal foramina. These last in *l. lepidus* equal 5×2.6 (*vide* Thomas).

The subspecies is based upon a series of four adults and one subadult from the Cromwell Mountains. Just as with *lepidus*, the color of the juvenal animal is duller, being less rufous and more grayish than that of the old specimens.

***Pogonomys lepidus derimapa*, new subspecies**

TYPE.—No. 101963, Amer. Mus. Nat. Hist.; ♀, adult; Mt. Derimapa, Gebroeders Gebirge, Dutch New Guinea, 1600 meters; August 16, 1930; collector, F. Shaw Mayer; collector's No. 169. The type is a skin and skull in good condition. (Note.—This specimen was identified by Dollman² as *P. sylvestris*.)

¹1890, Weber's 'Zool. Ergebnisse,' I, Pl. x, figs. 4-6.

²Rothschild and Dollman, 1933, Proc. Zool. Soc. London, p. 214.

GENERAL CHARACTERS.—A dull, rufous-colored *Pogonomys*, with belly hairs white to their roots. Very closely allied to *lepidus lepidus* and *lepidus huon*.

DESCRIPTION. Color substantially as in true *lepidus*, but slightly darker, coming nearest to hister, this color effect resulting from the admixture of considerable blackish to the russet of the back. Face and flanks paler as in other *lepidus*. Hands, feet, ears, and tail as in *lepidus*.

Skull representing the extreme of shortening of the palatal foramina to be found in *lepidus*, only 3.3 mm. in length. Tooth row and teeth large, as in *lepidus huon*.

MEASUREMENTS OF TYPE.—Head and body, 112 mm.; tail, 174; hind foot, 23; skull, occipitonasal length, 31.1; basal length, 27.5; zygomatic breadth, 17.2; interorbital width, 4.5; palatilar length, 4.1; palatal length, 16.2; palatal foramina, 3.3×1.9 ; length bulla, 4.2; upper molar series (alveoli), 5.4; upper molar crowns, 5.2; length crown m^1 , 2.3; width crown m^1 , 1.7.

This geographical race is founded upon the type and a second female in subadult pelage (Mayer field No. 133, A.M. No. 101961), which was referred by Dollman (*loc. cit.*) to *loriae*.

The Gebroeders form is darker in color than true *lepidus* and approximates the Huon Peninsula animals in general size. The shortening of the palatal foramina to be noted in *l. huon* is in the *l. derimapa* race carried still farther.

***Pogonomys (Chiruromys) forbesi satisfactus*, new subspecies**

TYPE. No. 79828, Amer. Mus. Nat. Hist.; ♂, adult; Goodenough Island (Dauala), D'Entrecasteaux group, east of New Guinea; November 18, 1924; collector, R. H. Beck, Whitney South Sea Expedition. The type is a specimen in alcohol in good condition (skull removed and cleaned).

GENERAL CHARACTERS.—A large, short-headed arboreal rat with long tail, the tip of which is highly prehensile. It differs from its mainland relatives in its longer hind foot and proportionately decreased length of skull. It comes closest both on structural and geographical grounds to *forbesi mambatus*.

DESCRIPTION. Color and pelage essentially as *forbesi*, a dull brownish-gray with hairs of under parts buffy white devoid of gray bases. No white mark above eye. Scale whorls of tail 6 per cm. Color of tail brownish gray. Scales keeled. The lack of white marks between eye and ear suggests *mambatus*.

Skull with very short rostrum, widely flaring zygomata, frontal processes of premaxillae extending far behind nasals, and all palatal and other characters proper to *Pogonomys (Chiruromys)*.

In length and breadth the skull of the type of *satisfactus* approximates the dimensions given by Thomas for *forbesi mambatus*. The palatal foramina, 3.8, are markedly shorter than those of *f. vulturnus* which equal 5.1. The diastema is only 9 (11.2 in *pulcher*). The molar series is rather longer, 5.9 instead of 5.7 (*mambatus*). In another male, however, it is 5.6.

MEASUREMENTS OF TYPE.—Tail, 225 mm.; hind foot, 37; skull, occipitonasal length, 35.0; zygomatic breadth, 21.7; interorbital breadth, 6.1; nasals, 11.6×3.4 ; diastema, 8.1; zygomatic plate, 37.; palatal foramina, 3.9; length bulla, 4.8; upper molar crowns, 6.0; length crown m^1 , 2.6; width crown m^1 , 1.9.

The form is based upon a series of two adult males and one juvenal male, all from the type locality.

***Pogonomys (Chiruromys) pulcher major*, new subspecies**

TYPE.—No. 79831, Amer. Mus. Nat. Hist.; ♀, adult; Goodenough Island (Dauila), D'Entrecasteaux group, east of New Guinea; November 18, 1924; collector, R. H. Beck, Whitney South Sea Expedition. The type is a specimen in alcohol in good condition (skull removed and cleaned).

GENERAL CHARACTERS.—A russet-bellied *Chiruromys* with much longer tail and hind foot than *p. pulcher*.

DESCRIPTION.—General color and quality of pelage essentially the same as in *p. pulcher*. Above dark grayish cinnamon; beneath light russet. A dark mystacial area joining the dark area around eye. Buffy whitish chin, lips, and throat. A whitish area surrounding each axillary mamma. Hairs of feet light brown. Tail very coarsely scaled, the scales of the dorsal surface near the base markedly larger than those of the ventral surface. (In *f. satisfactus* they are subequal.) A tendency for the dorsal scales near base to become coalesced in large masses (not observed in *f. satisfactus*). Scales unkeeled (keeled in *satisfactus*). Color brownish black (gray brown in *satisfactus*).

In the skull very few differences can be noted. The palate is slightly longer than in *satisfactus* due to setting back of the molar series, and the same cause has brought the median pterygoid fossa slightly forward in relation to the posterior level of the 3d molars. In the mandible the posterior margin (between articular and angular processes) is less excavated in *major* and the articular process is heavier.

MEASUREMENTS OF TYPE.—Tail, 245 mm.; hind foot, 37; skull, occipitonasal length, 37.4; zygomatic breadth, 22.3; interorbital breadth, 5.9; nasals, 11.0×4; diastema, 10.3; zygomatic plate, 3.9; palatilar length, 15.9; palatal foramina, 4.2; length bulla, 4.9; upper molar crowns, 6.0; length crown m¹, 2.7; width crown m¹, 1.9.

Apparently *pulcher* and *forbesi* represent two thoroughly distinct species, additional characters of which we have pointed out above. It is interesting to find representatives of both on the one island.

***Hydromys neobritannicus*, new species**

TYPE.—No. 99867, Amer. Mus. Nat. Hist.; ♀, adult; Bainings, Balayang, Wide Bay, New Britain, Solomon Islands; March 4, 1933; collector, W. F. Coultas, Whitney South Sea Expedition. The type is a skin and skull in good condition.

GENERAL CHARACTERS.—The generally melanic coloration of the under parts, black dorsal surfaces of fore and hind feet, the large size of the animal (hind foot 63, length of skull 56) and its wide m¹ set this species of *Hydromys* off sharply from any others hitherto described.

DESCRIPTION.—Length of dorsal pelage 10–13 mm., of ventral pelage 7–10. Color of dorsal fur very dark, the guard hairs almost black, although relieved by a glossy sheen, the wool hairs nearest to Vandyke brown. On the sides, thighs, arms, and cheeks the black hairs are replaced by shorter brownish-black hairs, but the tops

of hands and feet are again darker—almost black. Under parts Vandyke brown with a strong blackish cast on the anterior thoracic and abdominal region, but slightly paler on the posterior thoracic region and throat and neck. Ears nearly naked, near mummy brown. Tail black, with the terminal one and one-half inches buffy and a girdle of the same color for one inch at about its middle. Mammae 0-2=4.

Skull large and strongly built; rather similar in structure to that of *esox*. It differs, however, in the form of the pterygoids and especially in its larger and much wider molars. This added width of the molars encroaches upon the palate to such an extent that the distance apart of the two m^1 (3.7 mm.) only slightly exceeds the width of the individual molars (3.5 mm.). In *esox* the condition is quite different, the distance apart of the molars being 4.0 mm. and the width of individual molars only 2.7 mm. Differences between these two species in respect to this character can then be expressed by the very different fractions, $\frac{37}{35}$ and $\frac{40}{27}$. In the form of the hind part of the palate, yet another character appears. In *esox* the palate between the tooth rows is distinctly domed or arched upward, whereas in *neobritannicus* this part of the palate is nearly flat, being turned downward merely at the posterior margin.

MEASUREMENTS OF TYPE.—Head and body, 288 mm.; tail, 289; hind foot, 60; skull, occipitonasal length, 52.2; greatest (condylobasal) length, 54.7; zygomatic breadth, 28.4; interorbital breadth, 6.7; nasals, 17.7×5.5; interparietal, 6.3×9.7; diastema, 14.6; zygomatic plate, 3.5; palatilar length, 26.1; palatal foramina, 6.0×3.7; length bulla, 6.0; length molar crowns (m^1+m^2), 9.4; length crown m^1 , 6.7; width crown m^1 , 3.6.

This interesting new species is based upon a single female.

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RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 4

AN APPARENTLY NEW RACE OF WALLABIES FROM SOUTHERN NEW GUINEA

BY G. H. H. TATE AND RICHARD ARCHBOLD

Among the many interesting mammals collected by the Archbold Expedition to New Guinea may be mentioned a representative of the Australian rufous-legged pademelons inhabiting the mixed grasslands and gallery woods in the territory south of the Fly River.

***Macropus coxeni* oriomo, new subspecies**

TYPE.—No. 104429, Amer. Mus. Nat. Hist.; ♂, adult; Wuroi, Oriomo River, Western Division, Papua; February 2, 1934; collector, Richard Archbold. The type is a skin with skull in good condition.

GENERAL CHARACTERS.—A *Thylogale* wallaby of that section of wallabies that comprises the small, red-legged forms *coxeni* and *stigmaticus*. It may be distinguished from those forms by having the under parts washed with pinkish cinnamon instead of white (Thomas, 1888), and the hip-stripe ochraceous tawny instead of white. (In skins from north Queensland the hip-stripe is light tawny and the under parts show a trace of ochraceous wash.)

DESCRIPTION.—Pelage of type short, rather thin (much shorter and thinner than that of *stigmaticus* from north Queensland). Dorsal color much as in *coxeni*, mixed rufous and black running backward to the tail, becoming more rufous and less black on the flanks. Nape from behind ears to shoulders quite black. Front rufous, becoming more buffy on nose. Ears black, their inside hairs cinnamon buff, their bases surrounded by cinnamon flecked with black. Under parts light pinkish cinnamon, deepening at inguinal region to pinkish cinnamon and toward sides approaching orange cinnamon. Chin Mikado brown. Legs near orange cinnamon, their inner sides light pinkish cinnamon. Hip-stripe ochraceous tawny. Feet and hands Mikado brown. Tail above and near the base mixed rufous and blackish, the rest of the tail gray with a light covering of very short hairs near chamois in color.

The skull agrees closely in respect to the evenly rounded frontonasal suture with Thomas's (1888, Pl. viii) illustration of *coxeni*. Compared with the skull of *stigmaticus* (A. M. No. 65153, ♂, collected by Raven in north Queensland), practically no differences are observable either in size or conformation: a median keel on the basi-occipital is developed in *oriomo*; the opening for the infraorbital nerve comes a little closer to the zygomatic root in *stigmaticus*. Otherwise we can see no difference.

MEASUREMENTS OF TYPE.—Head and body, 575 mm.; tail, 390; hind foot (s.u.), 117; skull, basal length, 95; zygomatic breadth, 52; nasals, 40.1; palatilar length, 58.5; diastema (i^1-p^1 , alveoli), 20; m^1-m^3 , 17.4; length crown i^3 , 5.3.

This slightly differentiated race is founded upon a series of eight topotypes (including the holotype): 4 adult males, 1 subadult male, 1 juvenal male, and 2 juvenal females. These animals constitute, we believe, the first record of the presence in New Guinea of the red-legged pademelon wallabies and furnish yet another example of overlap of the north Australian fauna into southern New Guinea. The animals seem to be chiefly nocturnal, for most were shot by Mr. Archbold with the aid of a jacklight.

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NEW AMERICAN SPIDERS WITH NOTES ON OTHER SPECIES

By W. J. GERTSCH

CLUBIONIDAE

Phrurolithus C. Koch

In 1921, Dr. R. V. Chamberlin (Canadian Entomologist, LIII, pp. 69-70) separated the American species referred to the genus *Phrurolithus* into two groups. For one of these was erected the new genus *Phrurolithus*, with *P. formica* Banks as the type, a species which is characterized by its general dark color, the presence of a conspicuous femoral apophysis and a furcate tibial apophysis on the male palpus. In the other group were left such species as *P. alarius*, *palustris*, and *minutus*, in which the general color is much lighter, the femur of the male palpus is provided with a tubercular nodule, and the tibia of the palpus armed with a single retrolateral apophysis. A study of the genotype, the European *Phrurolithus festivus* C. Koch, shows that the dark forms referred to *Phrurolithus* are in all respects congeneric and that, if a new genus were needed, it should have been applied to the forms of which *alarius* is an example. While it is true that the characters on which these groups are based are in no way intergrading, the close agreement in general structure seems to make a new genus unnecessary.

The genus *Phrurolithus* in its broadest sense bids fair to be a large one in the United States. With the addition of seven new species below, the total number of species known from the region is now thirty-one. The male of *P. britcheri* Petrunkevitch is figured for the first time. The types of the new species described below are in the collection of The American Museum of Natural History.

Phrurolithus apertus, new species

Figures, 1, 2, and 3

MALE. -Total length, 1.69 mm. Carapace, 0.83 mm. long, 0.71 mm. wide.

Integument of the carapace light brown, glabrous, darkest in the eye region, with a median irregular, quadrangular black maculation from which extend forward four dark streaks to the posterior eye row. Sides with dark streaks and markings. Sternum, mouth parts and legs concolorous, a lighter brown than the carapace. Legs provided with short black hairs. Abdomen strongly sclerotized, glabrous, black

except for a transverse pale band near the middle. Sides of the abdomen mainly black, the venter and spinnerets white.

First row of eyes slightly narrower than the second, procurved, the medians separated by scarcely a radius, two-thirds as large as and subcontiguous with the laterals. Second row of eyes straight, the eyes subequal, the oval medians separated by half a radius, subcontiguous with the laterals. Median ocular quadrangle as long as broad, the anterior medians slightly smaller. Clypeus equal in height to about a radius of the anterior medians.

Carapace somewhat longer than broad, convex, the sutures obsolete. Pars cephalica at the second eye row five-eighths as broad as the carapace. Sternum as broad as long. Labium broader than long, half as high as the endites.

Tibia of the first two pairs of legs with six pairs, the metatarsi with three pairs of strong ventral spines. First leg: femur, 0.75 mm., patella, 0.30 mm., tibia, 0.72 mm., metatarsus, 0.67 mm., tarsus, 0.35 mm. long. Femur of first leg incrassated above at the base, the prolateral surface with two strong spines. Fourth leg: femur, 0.71 mm., patella, 0.29 mm., tibia, 0.62 mm., metatarsus, 0.63 mm., tarsus, 0.41 mm. long. Third and fourth legs unspined. Palpus, figures 1 and 2, the femoral apophysis near the middle of the joint.

FEMALE.—Total length, 1.75 mm. Carapace, 0.83 mm. long, 0.69 mm. wide.

Coloration as in the male, but the abdomen not so strongly sclerotized, clothed with gray hairs, the dorsum mainly black, variegated by numerous small white markings, the caudal end with a white maculation. Spinnerets white, ringed with black. Venter white.

Structure as in the male. Eyes as in the male, but the posterior medians distinctly separated from the laterals by half a radius, the medians a radius apart. Legs spined as in the male. First leg: femur, 0.66 mm., patella, 0.30 mm., tibia, 0.66 mm., metatarsus, 0.59 mm., tarsus, 0.30 mm. long. Last two pairs of legs without spines. Fourth leg: femur, 0.71 mm., patella, 0.30 mm., tibia, 0.63 mm., metatarsus, 0.66 mm., tarsus, 0.41 mm. long. Epigynum, figure 3.

TYPE LOCALITY.—Female holotype, male allotype, and female paratype from fifteen miles southwest of Harlingen, Texas, November 17, 1934 (S. Mulaik).

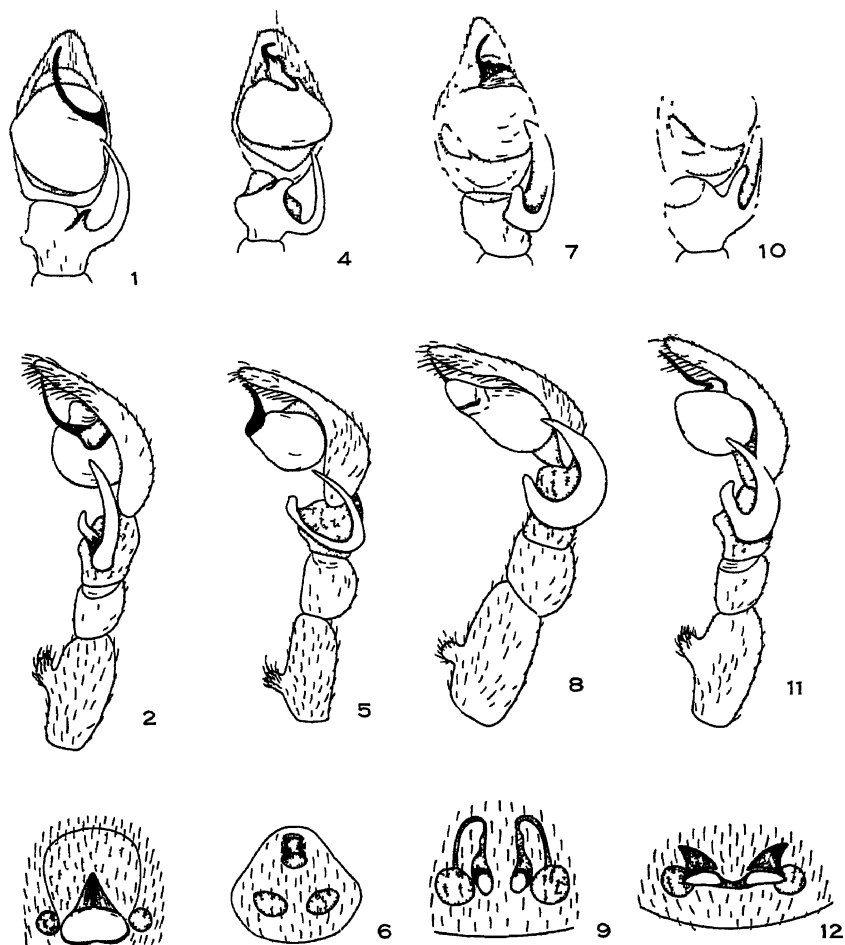
This species differs from all the others in the genus in having a single large atrial opening, rather than the conventional two more or less well-separated apertures. The long black embolus which originates on the retrolateral margin of the bulb is distinctive for the male.

***Phrurolithus delicatulus*, new species**

Figures 4, 5, and 6

MALE.—Total length, 2.00 mm. Carapace, 0.94 mm. long, 0.80 mm. wide.

Carapace dark brown, with an inconspicuous median quadrangular maculation and a few side streaks. Sternum infuscated on the margins. Mouth parts and legs yellow to light brown. All femora and tibiae with lateral black stripes, those on the first two femora broadened to cover most of the joint. Palpus infuscated. Abdomen glistening, glabrous, the dorsum with a pair of basal light spots and a transverse band. Venter pale. Spinnerets ringed in black.



- Fig. 1. *Phrurolithus apertus*, new species, left palpus, ventral view.
 Fig. 2. *Phrurolithus apertus*, new species, left palpus, retrolateral view.
 Fig. 3. *Phrurolithus apertus*, new species, epigynum.
 Fig. 4. *Phrurolithus delicatulus*, new species, left palpus, ventral view.
 Fig. 5. *Phrurolithus delicatulus*, new species, left palpus, retrolateral view.
 Fig. 6. *Phrurolithus delicatulus*, new species, epigynum.
 Fig. 7. *Phrurolithus britcheri* Petrunkevitch, left palpus, ventral view.
 Fig. 8. *Phrurolithus britcheri* Petrunkevitch, left palpus, retrolateral view.
 Fig. 9. *Phrurolithus callidus*, new species, epigynum.
 Fig. 10. *Phrurolithus camauxitae*, new species, left palpus, ventral view.
 Fig. 11. *Phrurolithus camauxitae*, new species, left palpus, retrolateral view.
 Fig. 12. *Phrurolithus camauxitae*, new species, epigynum.

Carapace rather strongly convex, the sides well rounded, the cephalic part very weakly produced, the sutures obsolete. Sternum as broad as long, the posterior coxae separated by nearly their length. Labium a little broader than long, more than half as high as the endites.

Eyes of the first row scarcely narrower than the second, procurved, the medians separated by a radius, subcontiguous with the larger laterals. Posterior row of eyes practically straight, the oval medians separated by a radius of their short axis, equidistant from the subequal laterals. Median ocular quadrangle as broad as long, equally wide in front as behind, the eyes subequal. Clypeus twice as high as the diameter of an anterior median eye.

Tibiae of the first two pairs of legs armed with five pairs of spines, the metatarsi with four pairs of ventral spines. First leg: femur, 0.68 mm., patella, 0.27 mm., tibia, 0.66 mm., metatarsus, 0.50 mm., tarsus, 0.35 mm. long. Third and fourth legs unspined. Fourth leg: femur, 0.68 mm., patella, 0.30 mm., tibia, 0.66 mm., metatarsus, 0.68 mm., tarsus, 0.44 mm. long. Femur of palpus with a stout knoblike apophysis, armed with stiff hairs, below near the base. Palpus, figures 4 and 5.

FEMALE.—Total length, 1.85 mm. Carapace, 0.84 mm. long, 0.66 mm. wide.

Color and structure essentially as in the male. Clypeus as high as one and one-half times the diameter of an anterior median eye. First leg: femur, 0.60 mm., patella, 0.25 mm., tibia, 0.53 mm., metatarsus, 0.49 mm., tarsus, 0.26 mm. long. First and second tibiae armed with five pairs, the metatarsi with three pairs of strong ventral spines. Last two legs unarmed. Fourth leg: femur, 0.66 mm., patella, 0.30 mm., tibia, 0.59 mm., metatarsus, 0.61 mm., tarsus, 0.38 mm. long. Epigynum, figure 6.

TYPE LOCALITY.—Male holotype, female allotype and paratypes from Montvale Springs, Tennessee, March 18, 1929 (W. M. Barrows).

Undoubtedly this species has been confused with *Phrurolithus similis* Banks, which it closely resembles. It is considerably smaller than that species, has the retrolateral apophysis of the tibia of the male palpus much more slender, and the embolus distinctly hooked at the end.

***Phrurolithus britcheri* Petrunkevitch**

Figures 7 and 8

Phrurolithus britcheri PETRUNKEVITCH, 1910, Annals New York Acad. Sci., XIX, p. 217, Pl. XXII, fig. 23.

RECORDS.—Woods Hole, Mass., July 24, 1901, females (Britcher). Onondaga County, New York, two males (Britcher).

***Phrurolithus camawhitae*, new species**

Figures 10, 11, and 12

MALE.—Total length, 2.46 mm. Carapace, 1.13 mm. long, 0.91 mm. wide.

Integument of the carapace light to dark brown, the margins with an inconspicuous narrow black seam, the sides and the striae with darker streaks and markings. Sternum, mouth parts and first coxae infuscated. First two femora mainly dark brown, the remainder of those legs and all the joints of the last two pairs dull yellow.

Carapace nearly glabrous, the few dark hairs inconspicuous. Legs with fine black hairs. Abdomen strongly sclerotized above, dark brown to black, the venter paler. Spinnerets yellow, ringed in black.

Carapace convex, evenly rounded above, narrowed in the head region, the sutures virtually obsolete. Sternum longer than broad (16 '15), broadest between the second coxae, narrowly rounded behind and separating the posterior coxae by half their width. Labium about as long as broad.

First row of eyes seven-eighths as broad as the second row, procurved, straight as viewed from above, the medians two-thirds as large as the laterals, separated by a radius, half as far from the laterals. Posterior eye row straight, the oval medians separated by a radius, as far from the slightly larger laterals. Median ocular quadrangle as broad as long, the eyes subequal. Clypeus as high as the diameter of an anterior median eye.

Tibia of the first leg with five (or six) pairs, the metatarsus with three pairs of strong ventral spines, the last pair not apical. Second legs shorter, spined as the first. Last leg without spines. First leg: femur, 1.00 mm., patella, 0.41 mm., tibia, 1.00 mm., metatarsus, 0.75 mm., tarsus, 0.45 mm. long. Fourth leg: femur, 0.95 mm., patella, 0.40 mm., tibia, 0.89 mm., metatarsus, 0.89 mm., tarsus, 0.56 mm. long. Palpus with a stout apophysis near the middle of the joint beneath the femur. Tibial apophysis and details of palpus, figures 10 and 11.

FEMALE.—Total length, 2.75 mm. Carapace, 1.00 mm. long, 0.80 mm. wide.

Color as in the male. Abdomen not glistening or strongly sclerotized above as in the male, almost uniform black, with a small white maculation just above the spinnerets, the venter gray. Structure essentially as in the male, the carapace proportionately longer. Oval median eyes of the posterior row nearer each other than the laterals. First leg: femur, 0.80 mm., patella, 0.35 mm., tibia, 0.80 mm., metatarsus, 0.69 mm., tarsus, 0.44 mm. long. Epigynum with the receptacles separated by about twice their diameter, the atrio-bursal orifice at the inner side of each receptacle.

TYPE LOCALITY.—Male holotype, female allotype and paratypes from Camp Mary White, Otero County, New Mexico, July and August, 1934 (S. Mulaik). Paratypes from Bear Creek Canyon, twenty miles southeast of Cloudcroft, Otero County, New Mexico, July 18–21, 1934 (S. Mulaik).

This species is closely related to *Phrurolithus pictus* and *pelvicolens* Chamberlin and Gertsch but has the femoral apophysis at about the middle of the joint. The female is easily separated by the position of the atrio-bursal orifices which are on a transverse line with the receptacles.

Phrurolithus callidus, new species

Figure 9

FEMALE.—Total length, 1.75 mm. Carapace, 0.80 mm. long, 0.66 mm. wide.

Integument of the carapace light brown, glabrous, the eyes enclosing a black area, the dorsum provided with a definite dorsal black maculation as in *apertus* but the whole carapace irregularly infuscated so as to disguise the pattern. Sternum infuscated on the margins, otherwise light brown, concolorous with the mouth parts

and the unmarked legs. Abdomen as in the female of *apertus* but with a broad dorsal white band. Venter light yellow.

Carapace convex, the sutures obsolete. Sternum as broad as long, the fourth coxae separated by about their length. Labium broader than long, half as high as the endites. First and second tibiae with five pairs, the metatarsi with three pairs of long ventral spines. First femur with two strong prolateral spines. First leg: femur, 0.70 mm., patella, 0.29 mm., tibia, 0.71 mm., metatarsus, 0.66 mm., tarsus, 0.41 mm. long. Last two pairs of legs without spines. Fourth leg: femur, 0.75 mm., patella, 0.30 mm., tibia, 0.70 mm., metatarsus, 0.75 mm., tarsus, 0.41 mm. long. Epigynum, figure 9.

Eyes of the first row slightly narrower than the second, procurved, the medians separated by a radius, half as far from the larger laterals. Second row of eyes straight, the oval medians more strongly divergent than in *apertus*, separated by one-third of their long diameter, equally distant from the subequal laterals. Median ocular quadrangle as long as broad, slightly narrower in front, the anterior medians smaller. Clypeus equal in height to half the diameter of an anterior median eye.

TYPE LOCALITY.—Female holotype from ten miles southeast of Edinburg, Texas, (October 20, 1934 (S. Mulaik). Female paratype from Harlingen, Texas, November 17, 1934 (S. Mulaik).

This tiny species is similar in color and structure to *Phrurolithus apertus*, new species, but differs in having two distinct atriobursal orifices and in the details of the eyes.

***Phrurolithus fratrellus*, new species**

Figure 21

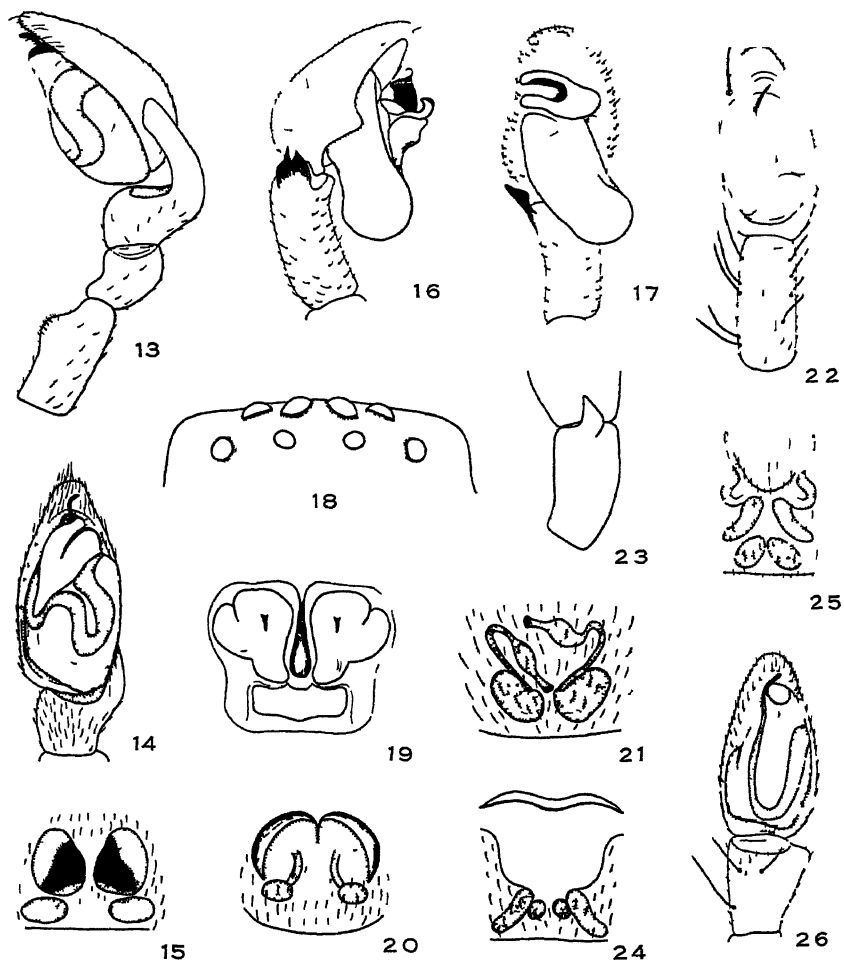
FEMALE.—Total length, 2.02 mm. Carapace, 0.77 mm. long, 0.62 mm. wide.

Integument of the carapace dull yellow, clothed sparsely with short black hairs, the eyes enclosing a black field but otherwise without markings. Sternum, mouth parts and legs concolorous with the carapace, unmarked, sparsely covered with short, inconspicuous black hairs. Dorsum of the abdomen white to light yellow, the venter unmarked, the dorsum gray at the base, darker caudally, with three light chevrons at the middle and a white maculation just above the white spinnerets.

Carapace longer than broad, convex, the sides moderately rounded, the pars cephalica about half as broad as the greatest width. Cephalic sutures obsolete. Sternum as broad as long. Labium a little broader than long, half as high as the endites.

First row of eyes slightly narrower than the second, weakly procurved as seen from in front, the medians separated by one-half their radius, subcontiguous with the subequal, oval laterals. Second row of eyes very weakly procurved, the oval medians scarcely separated (about one-sixth their diameter), about as far from the slightly smaller laterals. Median ocular quadrangle as broad as long, the anterior eyes slightly smaller. Clypeus equal in height to one-third the diameter of an anterior median eye.

Tibia of the first leg with five pairs, the metatarsus with four pairs of strong ventral spines. First femur with two prolateral spines in the distal half of the joint. Second leg as the first but lacking the prolaterals on the femur. Last two legs without spines. First leg: femur, 0.64 mm., patella, 0.30 mm., tibia, 0.62 mm., metatarsus,



- Fig. 13. *Phrurolithus wallacei*, new species, left palpus, ventral view.
 Fig. 14. *Phrurolithus wallacei*, new species, left palpus, retrolateral view.
 Fig. 15. *Phrurolithus wallacei*, new species, epigynum.
 Fig. 16. *Lauricius hemicloeinus* Simon, right palpus, retrolateral view.
 Fig. 17. *Lauricius hemicloeinus* Simon, right palpus, ventral view.
 Fig. 18. *Lauricius hemicloeinus* Simon, eyes from above.
 Fig. 19. *Lauricius hemicloeinus* Simon, epigynum.
 Fig. 20. *Phrurolithus emertoni*, new species, epigynum.
 Fig. 21. *Phrurolithus fratrellus*, new species, epigynum.
 Fig. 22. *Clubiona mulaiki*, new species, left palpus, ventral view.
 Fig. 23. *Clubiona mulaiki*, new species, tibia of left palpus, retrolateral view.
 Fig. 24. *Clubiona mulaiki*, new species, epigynum.
 Fig. 25. *Clubiona dorotheae*, new species, epigynum.
 Fig. 26. *Apostenus pacificus*, new species, left palpus, ventral view.

0.60 mm., tibia, 0.34 mm. long. Fourth leg: femur, 0.73 mm., patella, 0.31 mm., tibia, 0.60 mm., metatarsus, 0.71 mm., tarsus, 0.50 mm. long. Epigynum, figure 21.

TYPE LOCALITY.—Female holotype from Belton, Texas, September 1, 1933 (W. Ivie).

This tiny form is closely related to *Phrurolithus apertus* and *callidus* but has the eyes of the first row subequal; it differs considerably in characters of the epigynum as illustrated and completely lacks the well-marked black pattern on the carapace of the other species.

***Phrurolithus wallacei*, new species**

Figures 13, 14, and 15

MALE.—Total length, 2.30 mm. Carapace, 1.12 mm. long, 0.87 mm. wide.

Integument of the carapace light brown, the eye region dark, the sides with a marginal black seam, the dorsum with two black bands, the intervals between these bands forming a pale longitudinal central stripe as broad as the last eye row and submarginal pale bands half as broad as the dark stripes. Sternum light yellow, the mouth parts and legs light brown. Legs with narrow black bands, the first tibia mainly black. Dorsum of abdomen strongly sclerotized, shining, the light base marked with distinct chevrons. Venter pale.

Carapace longer than broad, the cephalic portion at the second eye row about three-fifths the greatest width of the carapace. Carapace convex, the longitudinal suture present. Sternum slightly longer than broad (15/14), the sides weakly rounded, bluntly pointed behind where the fourth coxae are separated by their width. Labium three-fifths as long as broad, about half as high as the endites.

Eyes of the first row very slightly narrower than the second, procurved, the medians separated by one-third their diameter, subcontiguous with the slightly larger laterals. Second row of eyes very weakly procurved, the medians one-fifth their diameter apart, twice as far from the subequal laterals. Median ocular quadrangle four-fifths as broad as long, slightly broader in front, the eyes subequal. Clypeus scarcely as high as the diameter of an anterior median eye.

Tibia of the first leg with seven pairs, the metatarsus with four pairs of long ventral spines. Tibia of the second leg with six pairs, the metatarsus with three pairs of long ventral spines. First femur slightly incrassated above at the base, the prolateral surface with two subdistal spines. All femora with a single dorsal spine near the base. Last two pairs of legs unarmed. First leg: femur, 1.21 mm., patella, 0.50 mm., tibia, 1.28 mm., metatarsus, 1.12 mm., tarsus, 0.45 mm. long. Palpus with a stout tubercle beneath the femur near the distal end. Tibia with a single broad apophysis (Figs. 13 and 14).

FEMALE.—Total length, 2.50 mm. Carapace, 1.12 mm. long, 0.93 mm. wide. Color and structure as in the male, the oval eyes of the posterior row equidistant, placed more obliquely, the median ocular quadrangle equally as broad behind as in front. Epigynum, figure 15.

TYPE LOCALITY.—Male holotype and paratypes from Alachua County, Florida, October 31, 1933 (H. K. Wallace). Female allotype from Benson Springs, Volusia County, Florida, October 11, 1933 (H. K. Wallace).

This species is closely allied to *Phrurolithus umbratilis* Crosby and Bishop but lacks the median dark maculation on the sternum. The embolus of the palpus of *P. wallacei* is distinctly curved as seen from the lateral aspect and the tibial apophysis is somewhat shorter. The first leg is proportionately much longer, the tibia exceeding the carapace in length (5/4), the same joint in *umbratilis* being slightly shorter than the carapace (8/9).

***Phrurolithus emertoni*, new species**

Figure 20

FEMALE.—Total length, 3.25 mm. Carapace, 1.33 mm. long, 1.06 mm. wide.

Integument of the carapace dirty yellow, the margins with a narrow dark seam, the dorsum with indistinct dark markings. Sternum, mouth parts and coxae concolorous with the carapace. Legs infuscated at the base of the first femora, otherwise dirty yellow. Abdomen grayish white to yellow, without marking. Carapace moderately convex, longer than broad, constricted in the head portion, the sides moderately rounded, the sutures weakly indicated. Sternum longer than broad (9/8). Labium two-thirds as long as broad, scarcely half as high as the endites.

First row of eyes as broad as the second, procurved, the medians four-fifths as large as the laterals, separated by a radius, subcontiguous with the laterals. Eyes of the second row very slightly procurved, the oval medians separated by a radius, half as far from the slightly larger laterals. Median ocular quadrangle longer than broad (6/5), as wide in front as behind, the anterior eyes slightly larger. Clypeus as high as two-thirds the diameter of an anterior median eye.

Tibia of the first two legs with seven pairs of stout spines that are about half as long as the joint, the metatarsi with three ventral pairs. Tibia and patella of the first leg as long as the carapace. Epigynum (Fig. 20) differing from the other species in presenting a shallowly excavated depression which leads to two large dark-colored semilunar orifices. Receptacles separated by twice their diameter.

TYPE LOCALITY.—Female holotype from Atlanta, Georgia, May, 1899 (J. H. Emerton).

The single female is in very poor condition and has lost any distinctive color markings that might have been present. However, the epigynum is quite unlike that organ in the known species of the genus.

***Apostenus* Westring**

***Apostenus pacificus*, new species**

Figure 26

MALE.—Total length, 3.35 mm. Carapace, 1.50 mm. long, 1.25 mm. wide.

Integument of the carapace uniform light brown, without markings, sparsely covered with inconspicuous black hairs. Eyes ringed in black. Clypeal margin with four long spines. Sternum yellowish brown, the mouth parts and legs darker, concolorous with the carapace. Integument of the abdomen gray to white, the venter light, the sides infuscated, the dorsum with a strongly sclerotized, yellowish-brown scutum that incompletely covers the upper surface.

Carapace slightly longer than broad, convex, broadest between the second and third coxae, weakly constricted to delimit the head portion, the cephalic sutures obsolete, the median longitudinal suture present. Sternum slightly longer than broad (22 '21), broadest at the second coxae, truncated in front, rounded behind between the fourth coxae, which are separated by their width. Labium broader than long (18 '13), half as high as the endites. Coxae subequal in length.

Eyes of the first row about four-fifths as broad as the second row, very weakly procurved as viewed from the front, the medians separated by scarcely a radius, subcontiguous with the larger medians. Eyes of the second row slightly recurved, the oval medians separated by the diameter of their short axis, as far from the subequal laterals. Median ocular quadrangle as long as broad, a little narrower in front, the anterior eyes slightly smaller. Clypeus equal in height to the diameter of an anterior median eye.

Legs evenly clothed with short, inconspicuous black hairs. First femur with two prolateral spines in the distal half and three dorsals. First tibia with six pairs and the metatarsus with three pairs of long ventral spines, the last pair not apical. Second leg as the first but lacking the prolaterals on the femur and having five pairs beneath the tibia. Third and fourth pairs of legs with three dorsal spines on the femora, three dorsal, prolateral and retrolateral and three pairs of ventral spines on the tibiae; a median, prolateral and retrolateral and two basal ventral pairs on the metatarsi. First leg: femur, 1.21 mm., patella, 0.59 mm., tibia, 1.15 mm., metatarsus, 0.92 mm., tarsus, 0.66 mm. long. Fourth leg: femur, 1.15 mm., patella, 0.57 mm., tibia, 1.02 mm., metatarsus, 1.15 mm., tarsus, 0.66 mm. long. Palpus, figure 26.

TYPE LOCALITY.—Male holotype and paratype from Los Angeles, California, November and December (G. Grant).

This is a smaller species than *Apostenus acutus* Emerton, and the tibial apophysis is much less strongly developed. The details of the bulb also present differences that are more easily shown in the figure than given verbal description. Neither of these species seems to be congeneric with *Apostenus inctipes* Banks, described from Washington State, but both agree well with the genotype, *A. fuscus* Westring.

AGROECA Westring

Agroeca trivittata (Keyserling)

Hilke trivittata KEYSERLING, 1887, Verh. k. k. Zool.-Bot. Gesell. Wien, XXXVI, p. 444, Pl. VI, fig. 17.

The genus *Hilke* is clearly a synonym of *Agroeca*.

Agroeca oaba (Chamberlin)

Herpyllus oabus CHAMBERLIN, 1919, Annals Ent. Soc. America, XII, p. 246, Pl. XVI, fig. 6.

Agroeca hesperia BANKS, 1921, Proc. California Acad. Sci., (4) XI, p. 101, Fig. 4.

Rachodassus flavus CHAMBERLIN AND WOODBURY, 1929, Proc. Biol. Soc. Washington, p. 134, Pl. II, fig. 2. (The legends are reversed on the plates.)

This species is found in the southwestern States from Utah and Arizona to California. It is probably identical with *trivittata*.

LAURICIUS Simon

Lauricius hemicloeiinus Simon

Figures 16, 17, 18, and 19

Lauricius hemicloeiinus SIMON, 1888, Ann. Soc. Entom. France, (6) VIII, p. 208. — CAMBRIDGE, 1900, 'Biologia Centrali-Americana,' Araneidea, II, p. 91, Pl. VII, fig. 1.

This large species, originally described from Mexico from the female, has been reported from Arizona and New Mexico.

SYRISCA Simon

Syrisca affinis (Banks)

Figures 31, 32, and 33

Teminius affinis BANKS, 1897, Canadian Entomologist, XXIX, p. 193.

This species has been reported only from Texas, where it appears to be common. The figures of the male palpus are from a male taken at Edinburg, Texas, by Mr. Stanley Mulaik. A figure of the epigynum of *Syrisca insularis* (Lucas), a Cuban species, is included for comparison (Fig. 34).

CLUBIONA Latreille

Clubiona mulaiki, new species

Figures 22, 23, and 24

MALE.—Total length, 4.20 mm. Carapace, 2.00 mm. long, 1.50 mm. wide.

Carapace and appendages mainly pale yellow, the eye region darker, the chelicerae and mouth parts light brown. Abdomen yellow, the dorsum with four rows of black spots in the caudal half.

Carapace longer than broad, convex, the head portion two-thirds as wide as the greatest width, sparsely armed with black hairs. Clypeal margin with seven principal long marginal spines, the median one between the anterior median eyes. Head sutures obsolete, the median longitudinal suture a linelike groove. Sternum longer than broad (25/19). Labium longer than broad (6/5), half as high as the endites.

Eyes of the first row narrower than the second (7/9), very weakly procurved as viewed from in front, the medians separated by their radius, a little nearer the slightly larger laterals. Second row of eyes very weakly procurved, the medians scarcely one and one-half times their diameter apart, a little nearer the subequal laterals. Median ocular quadrangle broader than long (9/7), narrower in front in the same ratio. Clypeus scarcely one-fourth as high as the diameter of an anterior median eye. Chelicerae with three small teeth on the lower margin.

Legs armed with stout black spines as follows. Femur of first leg with three dorsal and two prolateral spines. Tibia of first leg with three pairs and the metatarsus with a single basal pair of ventral spines. Second leg as the first but lacking the prolaterals on the femur. Femur of the third leg with three dorsal and one prolateral, the tibia

with one dorsal, two prolateral and retrolateral and three pairs of ventral spines; the metatarsus as the tibia but with an apical ring of spines and a single basal ventral pair. Fourth leg as the third but with three prolateral, retrolateral and three ventral pairs on the metatarsus. Femur and patella of the first leg as long as the carapace. Palpus similar to that of *Clubiona pallens* but lacking the small hook at the end of the tibial apophysis (Figs. 22 and 23).

FEMALE.—Total length, 4.12 mm. Color as in the male. Epigynum differing from that of *Clubiona pallens* in lacking a median finger-like appendage (Fig. 24).

TYPE LOCALITY.—Female holotype from seven miles east of Edinburg, Texas, February 8, 1935 (S. Mulaik). Male allotype from Edinburg, Texas, September, 1933 (S. Mulaik).

This is a much smaller species than *Clubiona pallens* Hentz but is closely related in most respects, the specific distinctions being in the details of the palpus and epigynum, which are figured.

Clubiona dorotheas, new species

Figure 25

FEMALE.—Total length, 3.25 mm. Carapace, 1.62 mm. long, 1.15 mm. wide.

Carapace mainly dirty white, with a linelike black streak from the posterior median eyes to the dorsal groove, the pars cephalica somewhat infuscated, the eye region darker. Chelicerae blackened. Labium, endites, and sternum infuscated, clothed with fine black hairs. Legs concolorous with the carapace, unmarked, clothed with fine black hairs and long spines. Dorsum of the abdomen gray, the sides darker, leaving a median longitudinal pale stripe that encloses five or six pairs of black spots. Venter gray.

Eyes of the first row narrower than the second (4/5), very weakly procurved, the medians separated by three-fourths their diameter, about half as far from the slightly larger laterals. Second row of eyes weakly procurved, the medians separated by one and one-half times their diameter, very slightly nearer the subequal laterals. Median ocular quadrangle broader than long (11/9), narrowed in front. Clypeus about one-fourth as high as the diameter of an anterior median eye. Chelicerae with three small teeth on the lower margin. Sternum longer than broad (32/25).

Legs armed with long black spines, the first leg missing, the second tibia with two ventral pairs, the last tibia with three ventral pairs of spines. Epigynum with a median finger-like appendage that is much broader than in *Clubiona pallida* Hentz.

TYPE LOCALITY.—Female holotype from Edinburg, Texas, September to December, 1933 (S. Mulaik).

The single female is in rather poor condition, lacking most of the legs, but the epigynum is clearly distinct from the other known forms. The specimen is abnormal in the possession of a well-developed additional diurnal eye which is situated some distance behind the right posterior lateral eye.

TRACHELAS L. Koch***Trachelas volutus*, new species**

Figures 27 and 28

MALE.—Total length, 5.10 mm. Carapace, 2.60 mm. long, 2.20 mm. wide.

Carapace and chelicerae dark reddish-brown, slightly roughened, clothed sparsely with inconspicuous scales, the eye region and clypeal margin with several short spines. Sternum, mouth parts, and first coxae lighter brown. First leg light reddish-brown, the other legs and their coxae light yellowish-brown, all clothed with fine black hairs, unspined. Dorsum of the abdomen strongly sclerotized, with a broad median pale reddish-brown band that encloses an inconspicuous black hastate marking at the base. Sides of the abdomen infuscated, the venter gray.

Carapace nearly as broad as long, slightly produced caudally, rounded in front, strongly convex, the median suture longitudinal, indistinct. Cephalic portion high, strongly convex, three-fourths as broad at the second eye row as the greatest width of the carapace (63/88), the cephalic sutures feebly distinct. Sternum longer than broad (55/43), the sides evenly rounded, the posterior coxae separated by one-third their width. Labium longer than broad (10/9), about two-thirds as high as the endites. Both margins of the cheliceral furrow with three teeth.

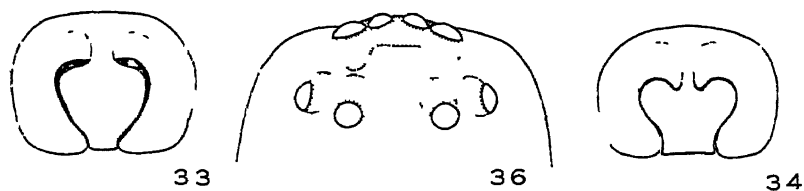
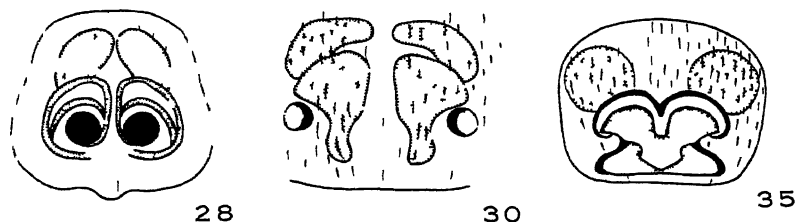
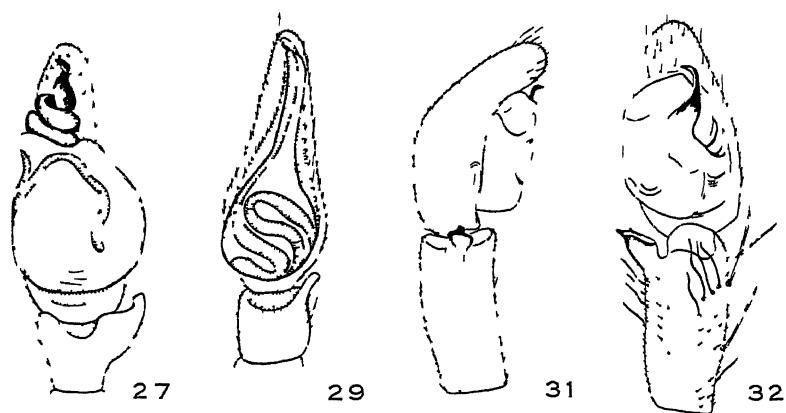
First row of eyes seven-tenths as broad as the second, slightly procurved, the medians separated by a radius, as far from the slightly smaller laterals. Second row of eyes five-sixths as broad as the carapace at the lateral eyes (50/65), strongly procurved, the medians separated by one and two-thirds their diameter, about two and one-half times their diameter from the slightly larger posterior lateral eyes. Median ocular quadrangle broader than long (10/8), narrowed in front in about the same ratio. Clypeus two-thirds as high as the diameter of an anterior lateral eye.

Legs 1234, the second and fourth pairs subequal, the first two pairs with rows of minute ventral spines. First leg: femur, 2.25 mm., patella, 1.10 mm., tibia, 1.75 mm., metatarsus, 1.60 mm., tarsus, 1.10 mm. long. Fourth leg: femur, 1.87 mm., patella, 0.87 mm., tibia, 1.60 mm., metatarsus, 1.81 mm., tarsus, 0.60 mm. long. Palpus, figure 27.

FEMALE.—Color and structure as in the male. Epigynum, figure 28.

TYPE LOCALITY.—Male holotype and female allotype from Edinburg, Texas, January 15, 1934 (S. Mulaik). Paratypes from seven miles east of Edinburg, Texas, October 12, 1932 (S. Mulaik). Paratypes from Dallas, Texas, August, 1934 (J. H. Robinson).

This species differs from *Trachelas tranquillus* (Hentz) in having the eyes of the posterior row unequally spaced, the medians being nearer together than their distance from the laterals. The embolus of the male palpus is strongly revolved for two turns and the remaining portion of the tube is much shorter than in *tranquillus*.



- Fig. 27. *Trachelas volutus*, new species, left palpus, ventral view.
 Fig. 28. *Trachelas volutus*, new species, epigynum.
 Fig. 29. *Mazax peregrina*, new species, left palpus, ventral view.
 Fig. 30. *Mazax peregrina*, new species, epigynum.
 Fig. 31. *Syrisca affinis* (Banks), right palpus, retrolateral view.
 Fig. 32. *Syrisca affinis* (Banks), right palpus, ventral view.
 Fig. 33. *Syrisca affinis* (Banks), epigynum.
 Fig. 34. *Syrisca insularis* (Lucas), epigynum.
 Fig. 35. *Gayennina britcheri*, new species, epigynum.
 Fig. 36. *Gayennina britcheri*, new species, eyes, dorsal view.

MAZAX O. P. Cambridge***Mazax peregrina***, new species

Figures 29 and 30

MALE.—Total length, 3.80 mm. Carapace, 1.60 mm. long, 0.97 mm. wide.

Carapace uniform dark reddish-brown, sparsely clothed with inconspicuous black hairs, the eyes ringed with black. Sternum and mouth parts lighter brown, the coxae paler. Legs yellowish brown, the femora of the first two pairs with prolateral dark stripes, the metatarsi of the first and fourth legs darkened. Palpus all brown. Abdomen dark reddish-brown, the dorsum with seven transverse pale stripes.

Carapace much longer than broad, convex, highest just behind the eyes, evenly sloping to the somewhat produced caudal margin, the sutures obsolete. Pairs cephalica more than half as broad as the greatest width (25/38). Sternum longer than broad (23/30), pointed behind and separating the coxae by about half their width. Labium broader than long (10/6), half as high as the endites. Abdomen strongly sclerotized, the venter smooth and shining, sparsely provided with hairs, the sides rugose, the dorsum rugose in the anterior half, smoother behind, the roughness due to the tubercular bases from which issue the long black hairs. Base of the abdomen strongly constricted to form a roughened petiole, immediately caudad of which are two robust upright spines. Middle of the abdomen constricted.

Eyes of the first row narrower than the second (53/65), very weakly procurved, the medians separated by two-thirds their diameter, one-half their radius from the equal laterals. Second row of eyes more than three-fourths as broad as the width of the carapace at that point (13/16), very weakly recurved, the medians separated by a diameter, two-thirds as far from the equal laterals. Median ocular quadrangle broader than long (35/28), narrowed in front in the same ratio. Clypeus as high as one and one-fourth times the diameter of an anterior lateral eye. Lower margin of the furrow of the chelicera with two subcontiguous teeth.

Legs 4123, the second and third pairs subequal. Fourth femur with a very strong dorsal spine near the base, the other femora with a weak spine in the same position. First tibia with two submedian pairs of weak ventral spines, the distals lacking. Fourth tibia with a subproximal, median, and distal ventral pair of weak spines. Palpus, figure 29. First leg: femur, 0.95 mm., patella, 0.32 mm., tibia, 0.95 mm., metatarsus, 0.75 mm., tarsus, 0.50 mm. long. Fourth leg: femur, 1.25 mm., patella, 0.43 mm., tibia, 1.20 mm., metatarsus, 1.30 mm., tarsus, 0.60 mm. long.

FEMALE.—Total length, 3.75 mm. Carapace reddish brown, with a few black side streaks and an indistinct triangular black maculation just in front of the dorsal groove. First two legs mainly yellow, the femora darkened at the base, the last two mainly dark brown, the tarsi distally or altogether pale yellow, the other joints with longitudinal dark bands or completely darkened. Abdomen coriaceous, finely punctate, the base of the dorsum with a large oval scutum. Pedicel normal. Structure of carapace and eye relations as in the male. Legs comparatively shorter, the patella and tibia of the fourth pair shorter than the carapace (1.60 mm./1.75 mm.). Length of a female paratype, 4.25 mm.

TYPE LOCALITY.—Female holotype, male allotype, and paratypes from five miles south of San Juan, Texas, February 22, 1935 (S. Mulaik). Female paratype from Edinburg, Texas, March 10–15, 1934 (S. Mulaik).

Female paratype from Brownsville, Texas, November 30, 1934 (S. Mulaik).

The females of the Mexican species of *Mazar* have the abdomen pedicellate as in the male and also have the basal scutum provided in front with two robust spines. In the female of *Mazar peregrina* the abdomen is practically normal and the basal scutum completely lacks the strong spines of the other species. The male of *peregrina* differs from *Mazar spinosa* in having transverse pale bands on the dorsum of the abdomen but is virtually identical in structure.

MICARIA Westring

Micaria emertoni, new name

Micaria quinquenotata EMERTON, 1909, Trans. Connecticut Acad. Arts and Sciences, XIV, p. 215, Pl. x, fig. 1. (Not *Micaria quinquenotata* Simon.)

Micaria imperiosa, new species

Figure 37

MALE.—Total length, 5.00 mm. Carapace, 2.65 mm. long, 1.45 mm. wide.

Carapace dark chestnut brown, the midline with an indistinct V-shaped black figure just in front of the dorsal groove from which black streaks go to the posterior eye row. Sides with a few black streaks that originate at the dorsal groove and run to the inconspicuous narrow marginal black seam. Carapace with a few white scales on the sides and a few erect black spines in the eye region. Sternum, mouth parts and coxae dark reddish-brown. Appendages concolorous with the carapace but the joints beyond the femora of the first two pairs of legs paler, the legs with dorsal and lateral stripes of white scales. Dorsum of abdomen mainly black, clothed with metallic scales, the sides with a basal patch of white scales and a larger patch at the constriction of the abdomen. Venter black at the distal end, light brown at the base.

Carapace much longer than broad, convex, highest just behind the eye group and from there evenly sloping to the caudal margin, the pars cephalica broad, two-thirds as wide as the greatest width of the carapace at the second eye row. Sternum longer than broad (50/35), clothed with erect black hairs. Labium longer than broad (8/6). Lower margin of the furrow of the chelicera with a single small tooth. Abdomen twice as long as broad, strongly constricted at the middle.

First row of eyes narrower than the second (16/22), procurved, a line along the dorsal edges of the laterals touches the lower edges of the medians, the median eyes separated by about their radius, half as far from the slightly larger laterals. Second row of eyes half as wide as the width of the head at that point, procurved in the same degree as the first eye row, the medians separated by slightly more than their diameter, a diameter from the subequal laterals. Median ocular quadrangle slightly broader than long (11/10), narrowed in front (8/11), the posterior eyes larger. Clypeus about twice the diameter of an anterior median eye.

Legs 4123, the femora with a single subproximal and a subdistal dorsal spine, the first two legs otherwise unspined, the last two with paired or unpaired spines beneath the tibiae and metatarsi. First two legs with numerous fine black spines beneath.

First leg: femur, 1.92 mm., patella, 0.85 mm., tibia, 1.75 mm., metatarsus, 1.50 mm., tarsus, 1.25 mm. long. Fourth leg: femur, 2.42 mm., patella, 0.90 mm., tibia, 2.03 mm., metatarsus, 2.00 mm., tarsus, 1.30 mm. long. Palpus, figure 37.

TYPE LOCALITY.—Male holotype from five miles east of Dryden, Texas, summer of 1934 (S. Mulaik). Immature paratypes from Sander-son, Texas, July 4, 1934 (S. Mulaik).

This large *Micaria* and the three following species form a group in which the bulb is not provided with a hooked apophysis. The emboli and the tibial apophyses differ in each of the species as shown in the figures.

***Micaria altana* Gertsch**

Figure 38

Micaria altana GERTSCH, 1933, American Museum Novitates, No. 637, p. 6, Fig. 5.

As the male of this species has not as yet been described, a figure of the palpus is included for comparison with *Micaria imperiosa*. The species is now known to occur in Colorado, Utah and Idaho, and in Alberta, Canada.

***Micaria foxi* Gertsch**

Figure 39

Micaria foxi GERTSCH, 1933, American Museum Novitates, No. 637, p. 5, Fig. 2.

In the description of this species and *Micaria utahna* Gertsch the embolus is described as a fine long tube that curves around the prolateral margin of the bulb. As this is not the case, this part of the description and the figures illustrating the emboli are to be considered spurious. Corrected figures are included in this paper. Only the male types of the two species are known.

***Micaria utahna* Gertsch**

Figure 40

Micaria utahna GERTSCH, 1933, American Museum Novitates, No. 637, p. 4, Fig. 1.

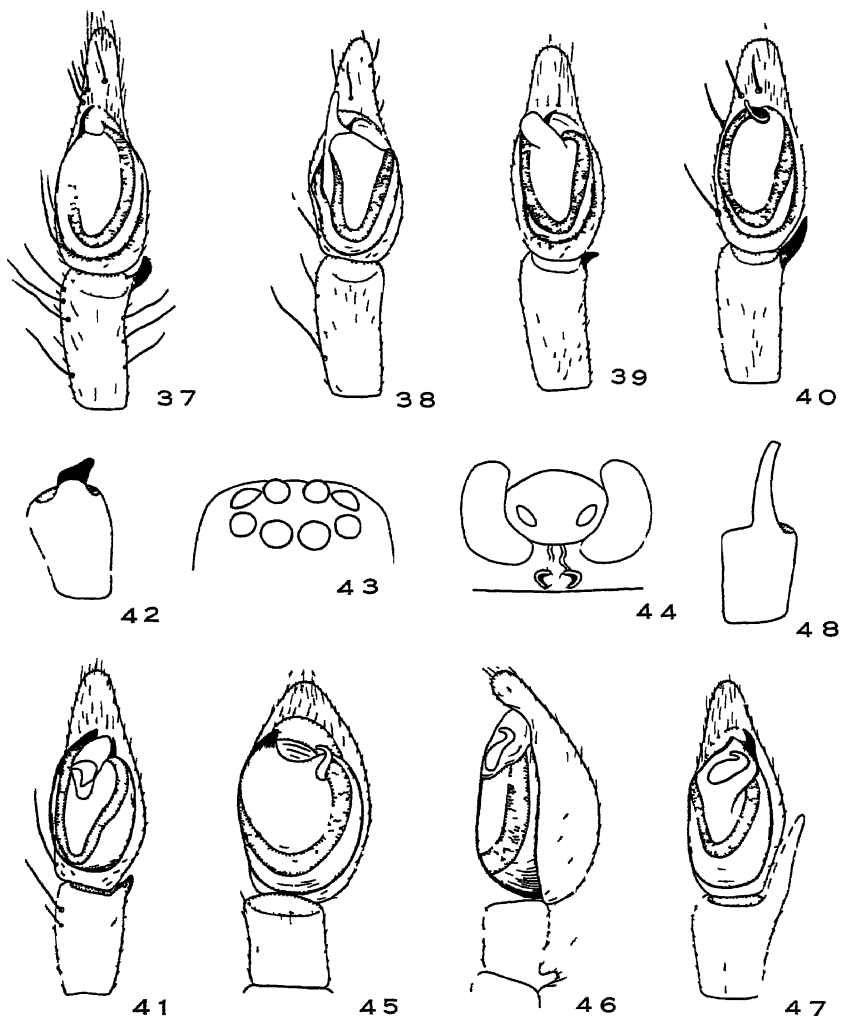
***Micaria mormon*, new species**

Figures 41, 42, and 43

MALE.—Total length, 3.16 mm. Carapace, 1.42 mm. long, 1.08 mm. wide.

Carapace and appendages uniform golden-brown. Dorsum of abdomen gray, clothed with iridescent scales, the venter paler.

Carapace longer than broad, convex, highest at the last eye row, sloping slightly caudad to the dorsal groove and then more abruptly to the posterior margin, the dorsum sparsely clothed with short erect black hairs. Pars cephalica rather broad, nearly two thirds as wide at the second eye row as the greatest width (26/34).



- Fig. 37. *Micaria imperiosa*, new species, left palpus, ventral view.
 Fig. 38. *Micaria altana* Gertsch, left palpus, ventral view.
 Fig. 39. *Micaria foxi* Gertsch, left palpus, ventral view.
 Fig. 40. *Micaria utahna* Gertsch, left palpus, ventral view.
 Fig. 41. *Micaria mormon*, new species, left palpus, ventral view.
 Fig. 42. *Micaria mormon*, new species, tibia of left palpus, retrolateral view.
 Fig. 43. *Micaria mormon*, new species, eyes, dorsal view.
 Fig. 44. *Micaria triangulosa*, new species, epigynum.
 Fig. 45. *Micaria triangulosa*, new species, left palpus, ventral view.
 Fig. 46. *Micaria triangulosa*, new species, left palpus, retrolateral view.
 Fig. 47. *Micaria nanella*, new species, left palpus, ventral view.
 Fig. 48. *Micaria nanella*, new species, tibia of left palpus, retrolateral view.

Sternum slightly longer than broad (11/9). Labium broader than long (10/9). Chelicerae with a single small tooth on the lower margin. Abdomen two-thirds as broad as long (14/9), uncontracted.

Eyes very large for the genus, the first row slightly narrower than the second (11/12), procurved, the medians separated by scarcely a radius, subcontiguous with the slightly smaller laterals. Second row of eyes two-thirds as wide as the head at that point, procurved, the medians separated by one-third their diameter, as far from the slightly smaller lateral eyes. Median ocular quadrangle longer than broad (27/23), as broad in front as behind, the eyes subequal. Clypeus a little more than half as high as the diameter of an anterior lateral eye.

Legs 4123, the first and second femora with a basal spine above, the last two femora with an additional submedian spine. Posterior legs with paired and unpaired spines beneath, the first two pairs unarmed. First leg: femur, 1.40 mm., patella, 0.70 mm., tibia, 1.30 mm., metatarsus, 0.90 mm., tarsus, 0.85 mm. long. Fourth leg: femur, 1.50 mm., patella, 0.62 mm., tibia, 1.35 mm., metatarsus, 1.35 mm., tarsus, 0.85 mm. long. Palpus, figures 41 and 42.

TYPE LOCALITY.—Male holotype from City Creek Canyon, Salt Lake City, Utah, June 14, 1931 (Gertsch).

The unusually large size of all the eyes in this species (Fig. 43) will separate it from any described form. In all other respects it is a typical *Micaria*.

***Micaria nanella*, new species**

Figures 47 and 48

MALE.—Total length, 1.75 mm. Carapace, 0.09 mm. long, 0.60 mm. wide.

Carapace dark brown, somewhat streaked with black, clothed with a few white scales. Sternum, labium, and endites brown, the coxae lighter. Femora of all the legs with lateral dark bands, the other joints yellowish brown. Abdomen black, clothed with metallic scales, with a transverse white maculation at the middle of the dorsum, the venter distally black, dirty white at the center, the base brown.

Carapace longer than broad, strongly convex, highest well behind the eyes, the cephalic and median sutures obsolete. Head broad as in *Micaria liticeps* Emerton, the width at the second eye row three-fourths the greatest width of the carapace (12/17). Sternum longer than broad (7/5). Labium as broad as long. Lower margin of the furrow of the chelicera unarmed. Abdomen with a weak dorsoventral constriction at the middle.

Eyes of the first row narrower than the second (4/3), very weakly procurved, the medians separated by one diameter, subcontiguous with the subequal laterals. Second row of eyes two-thirds the width of the carapace, slightly procurved, the medians separated by one and one-half times their diameter, as far from the equal laterals. Median ocular quadrangle slightly longer than broad (10/9), slightly narrower in front (10/8), the eyes subequal. Clypeus twice as high as the diameter of an anterior lateral eye.

Legs 4123, the first three pairs with a dorsal proximal spine, the last two with an additional median dorsal spine on the femora. Last two legs with very weak, paired spines beneath the tibiae and metatarsi. First leg: femur, 0.51 mm., patella, 0.23

mm., tibia, 0.46 mm., metatarsus, 0.40 mm., tibia, 0.35 mm. long. Fourth leg: femur, 0.67 mm., patella, 0.23 mm., tibia, 0.60 mm., metatarsus, 0.60 mm., tarsus, 0.41 mm. long.

TYPE LOCALITY.—Male holotype from Sanderson, Texas, July 4, 1934 (S. Mulaik). Male paratype from Harlingen, Texas, November 7, 1934 (S. Mulaik).

This tiny species is distinct from *Micaria laticeps* Emerton, which it resembles in the very broad pars cephalica, in the possession of a very long tibial apophysis of the palpus. In the latter character the species resembles *Micaria longispina* Emerton, but the proportions of the tibial apophysis are different and the head in *laticeps* is not so broad.

***Micaria triangulosa*, new species**

Figures 44, 45, and 46

FEMALE.—Total length, 3.50 mm. Carapace, 1.10 mm. long, 0.65 mm. wide.

Carapace uniform bright golden-brown, provided with a few inconspicuous black hairs, the eyes ringed in black. Sternum, mouth parts, and coxae yellowish brown. First two femora dark brown, the remaining joints of those legs white. Last two legs colorous with the carapace, lined with black. Abdomen black at the distal end and with a submedian transverse black band, the whole dorsum thickly clothed with golden scales, the venter white.

Carapace longer than broad, convex, highest near the middle, gently sloping to the front, evenly sloping caudally to the margin. Sternum longer than broad (25/18). Labium as broad as long. Lower margin of the furrow of the chelicera with a single small tooth. Abdomen twice as long as broad, unconstricted. Epigynum, figure 44.

Eyes of the first row narrower than the second (30/36), procurved, the medians separated by three-fourths their diameter, subcontiguous with the larger laterals. Posterior eye row three-fifths as wide as the carapace at that point, procurved, the median eyes separated by one-half their diameter, as far from the slightly larger lateral eyes. Median ocular quadrangle slightly longer than broad (10/9), narrowed in front (10/8), the posterior eyes slightly larger. Clypeus two-thirds as high as the diameter of an anterior lateral eye.

Legs 4123, all the femora with a single weak proximal spine above. First two legs otherwise unarmed, the last two with weak, paired spines beneath the tibiae and metatarsi. First leg: femur, 0.62 mm., patella, 0.30 mm., tibia, 0.45 mm., metatarsus, 0.45 mm., tarsus, 0.37 mm. long. Fourth leg: femur, 0.80 mm., patella, 0.35 mm., tibia, 0.60 mm., metatarsus, 0.75 mm., tarsus, 0.45 mm. long.

MALE.—Total length, 2.00 mm. Color somewhat darker but pattern and structure as in the female. Palpus, figures 45 and 46.

TYPE LOCALITY.—Male holotype and female allotype from ten miles southeast of Edinburg, Texas, October 20, 1934 (S. Mulaik). Female paratype from northwest of Edinburg, Texas, September 3, 1934 (S. Mulaik). Immature paratypes from Sanderson, Texas, July 4, 1934 (S. Mulaik).

This beautiful little species is closely related to *Micaria aurata* (Hentz) but differs conspicuously in size and in the finer details of the epigynum and palpus. The carapace is not so convex as in *aurata*, the abdomen is unconstricted, and the eyes of the posterior row are much closer together, less than a diameter apart.

ANYPHAENIDAE

GAYENNINA, new genus

First row of eyes straight as seen from in front, slightly recurved as viewed from above, the eyes subcontiguous, the medians slightly smaller. Second row of eyes much broader, procurved, the medians nearer the equal lateral eyes. Median ocular quadrangle as broad as long, greatly narrowed in front. Carapace much broader than long, the pars cephalica half as wide as the greatest width. Chelicerae with two teeth on the lower margin. Sternum and labium longer than broad. Fourth leg longer than the first. First tibiae with three pairs of ventral spines, the metatarsi with a single pair at the base. Tracheal spiracle midway between the epigynum and the spinnerets.

This interesting genus differs from *Gayenna* in having the tracheal spiracle situated midway between the genital furrow and the spinnerets, instead of having it well behind the middle of the abdomen. It agrees with *Gayenna* in having two teeth on the lower cheliceral margin and in the procurved posterior eye row. In *Anyphaena* the lower cheliceral margin is armed with a series of minute teeth and the posterior eye row is straight.

Gayennina britcheri, new species

Figures 35 and 36

FEMALE.—Total length, 5.25 mm. Carapace, 2.50 mm. long, 1.90 mm. wide.

Integument of the cephalothorax light yellowish-brown, clothed with soft white hairs, the clypeal margin with several long black spines. Carapace with three small submarginal brown spots on each side. Eyes ringed with black. Sternum yellow, the mouth parts, coxae and legs darker, without conspicuous markings. Abdomen mainly gray, the dorsum with a narrow reddish-brown longitudinal stripe the full length and inconspicuous narrow side stripes.

Carapace much longer than broad, narrowly rounded on the sides, the front half as broad as the greatest width, rather low, evenly convex, equally high for most of the length, the median longitudinal furrow distinct, located two-thirds of the length back, the cephalic sutures obsolete. Sternum longer than broad (21/15), the sides weakly rounded, caudally narrowly rounded where the fourth coxae are separated by one-third of their width. Labium slightly longer than broad (6/3), half as high as the parallel endites. Chelicerae with two teeth on the lower margin.

Eyes of the first row much narrower than the second (7/11), straight as viewed from in front, the smaller medians separated by one-half their radius, subcontiguous with the laterals. Second row of eyes procurved, the medians separated by two diameters, half as far from the subequal laterals. Median ocular quadrangle as broad as

long, greatly narrowed in front ($5/2$), the anterior medians much smaller. Quadrangle of the posterior median eyes and the anterior laterals as broad as long, slightly narrower behind than in front, the anterior lateral eyes somewhat larger. Clypeus equal in height to the diameter of an anterior median eye. Eyes, figure 36.

Fourth leg longer than the first, the tibia and metatarsus with three pairs of ventral spines, the distal part of the metatarsus and the tarsus scopulate. Tibia of the first leg with three pairs of ventral spines, the metatarsus with a single basal pair, the metatarsus and tarsus scopulate throughout their length. First leg: femur, 2.00 mm., patella, 0.90 mm., tibia, 1.70 mm., metatarsus, 1.35 mm., tarsus, 0.90 mm. long. Second leg about equal in length. Fourth leg: femur, 2.40 mm., patella, 1.00 mm., tibia, 2.12 mm., metatarsus, 1.90 mm., tarsus, 0.90 mm. long. Epigynum, figure 35.

TYPE LOCALITY.—Female holotype and paratype from Woods Hole, Massachusetts, July 2, 1901 (Britcher).

Miss Bryant has informed me that Mr. Emerton knew this species well but was never able to get a mature specimen for description. Since I have seen an immature female from Michigan in addition to the two examples from Massachusetts it appears that the species is rather widely distributed.

CTENIDAE

Ctenus captiosus, new species

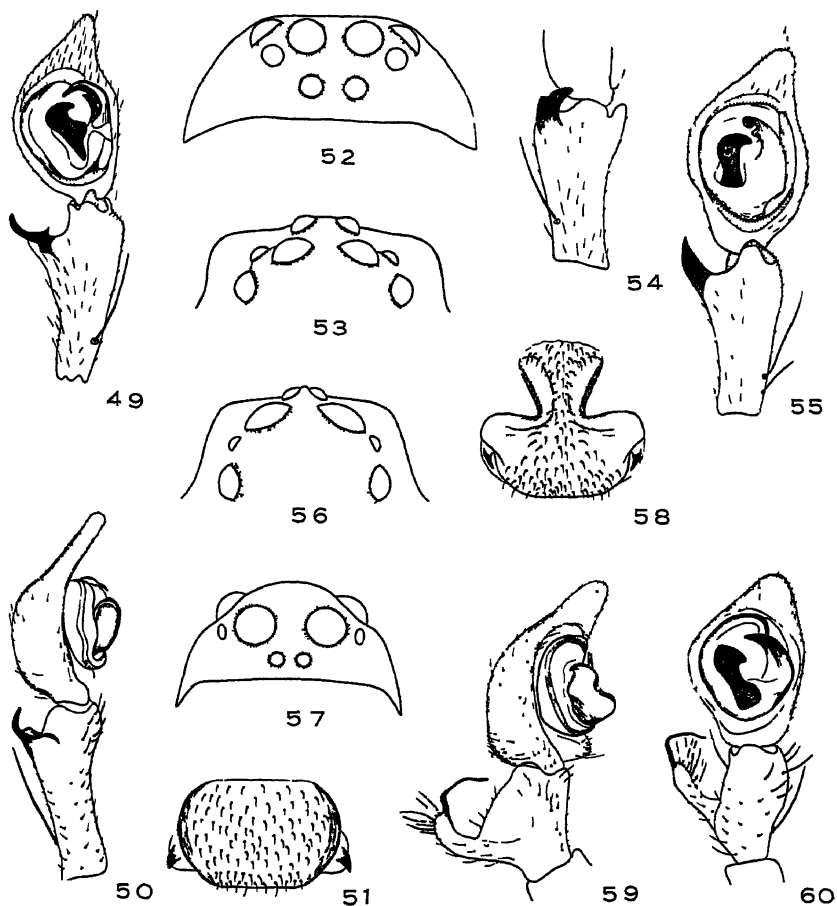
Figures 49, 50, 51, 52, and 53

MALE.—Total length, 15.00 mm. Carapace, 7.44 mm. long, 5.64 mm. wide.

Carapace dark reddish-brown, with a median light stripe as broad as the posterior row that is abruptly narrowed caudad of the middle of the carapace. Sides with an indistinct submarginal light band. Striae outlined in black, the eyes on a black field. Carapace covered with soft gray hairs, the clypeal margin provided with long black spines. Sternum, mouth parts and coxae light brown, the legs somewhat darker, concolorous with the carapace. Dorsum of the abdomen dark gray to black, with a broad, deeply notched median light yellow stripe, the venter paler, with a few black markings but lacking the converging black lines characteristic of *Ctenus hibernalis*.

Carapace longer than broad, the sides well rounded, the head portion three-sevenths as broad as the greatest width. Carapace about equal in height from the eyes to the posterior declivity. Pars cephalica blending well with the thoracic portion, the sutures indistinct, the median longitudinal suture a long deep groove. Sternum longer than broad (41/38), subround, the last coxae scarcely separated at their bases. Labium three-fourths as long as broad, half as high as the endites. Coxae subequal.

Eyes of the first row more than five-sixths as broad as the second row, very strongly recurved, the medians separated by their radius, scarcely a diameter from the smaller laterals which are about a radius from the median eyes of the second row. Eyes of the second row strongly recurved, the medians separated by a radius, a little farther from the subequal laterals. Median ocular quadrangle about as long as broad, considerably narrowed in front, the anterior eyes smaller. As viewed from above the anterior lateral eyes are on a line with the posterior medians, within a radius of the posterior laterals. Eyes, figures 52 and 53. Clypeus a little more than half the



- Fig. 49. *Ctenus captiosus*, new species, right palp, ventral view.
 Fig. 50. *Ctenus captiosus*, new species, right palp, retrolateral view.
 Fig. 51. *Ctenus captiosus*, new species, epigynum.
 Fig. 52. *Ctenus captiosus*, new species, eyes, frontal view.
 Fig. 53. *Ctenus captiosus*, new species, eyes, dorsal view.
 Fig. 54. *Ctenus hibernalis* Hentz, tibia of right palp, retrolateral view.
 Fig. 55. *Ctenus hibernalis* Hentz, right palp, ventral view.
 Fig. 56. *Leptoctenus byrrhus* Simon, eyes, dorsal view.
 Fig. 57. *Leptoctenus byrrhus* Simon, eyes, frontal view.
 Fig. 58. *Leptoctenus byrrhus* Simon, epigynum.
 Fig. 59. *Leptoctenus byrrhus* Simon, right palp, retrolateral view.
 Fig. 60. *Leptoctenus byrrhus* Simon, right palp, ventral view.

diameter of an anterior median eye. Chelicerae armed with five teeth on the lower margin, three on the upper.

First and second tibiae with four pairs, the metatarsi with three pairs of long ventral spines. Third and fourth tibiae and metatarsi with three pairs of ventral spines. Palpus, figures 49 and 50.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	7.86	3.36	7.89	6.76	3.00	28.86 mm.
II	7.11	3.18	6.75	6.36	2.61	26.01 mm.
III	6.36	2.61	5.43	6.00	2.40	22.80 mm.
IV	8.25	3.00	7.50	10.14	3.36	32.25 mm.

FEMALE.—Total length, 18.00 mm. Carapace, 7.25 mm. long. Total length of a female paratype, 22.50 mm.

Color and structure essentially as in the male. Legs proportionately shorter. First leg: femur, 7.35 mm., patella, 3.45 mm., tibia, 7.50 mm., metatarsus, 6.24 mm., tarsus, 2.25 mm. long. Total length, 26.79 mm. Epigynum of an immature female, figure 51. The epigynum of mature females agrees well with that of *Ctenus hibernalis* Hentz.

TYPE LOCALITY.—Male holotype from Seahorse Island, Levy County, Florida, May 1, 1934 (A. F. Carr). Female allotype from Alachua County, Florida, May 8, 1934 (H. K. Wallace). Male paratype from Gainesville, Florida, February 22, 1933 (H. K. Wallace). Female paratype from Alachua County, Florida, April, 19, 1934 (H. K. Wallace). Immature paratypes from various localities in Alachua and Lake Counties, Florida (H. K. Wallace).

***Ctenus hibernalis* Hentz**

Figures 54 and 55

Ctenus hibernalis HENTZ, 1844, Jour. Boston Soc. Nat. Hist., IV, p. 393, Pl. XIX, figs. 1-4.

A male of this species from Warrior River, Jefferson County, Alabama, April 1, 1912 (H. H. Smith), kindly sent to me by Dr. C. R. Crosby, is figured for comparison with *Ctenus captiosus*, new species. The species are closely allied structurally but can be separated by the details of the tibial apophyses.

***Leptoctenus byrrhus* Simon**

Figures 56, 57, 58, 59, and 60

Leptoctenus byrrhus SIMON, 1888, Ann. Soc. Entom. France, (6) VIII, p. 210.

Ctenus byrrhus F. CAMBRIDGE, 1900, 'Biologia Centrali-Americana,' Araneidea, II, p. 113, Pl. VIII, fig. 9.

This is a common species in southern Texas, where examples of both sexes have been collected by Mr. Stanley Mulaik. As I am not sure of the generic placement, I have left it in the genus in which it was described. The figures are sufficient to separate it from the other two species.

May 24, 1935

¹American Museum Novitates Nos. 425, 487, and 755 comprise parts I to III of this series.

shining and extending from the humeri almost to the posterior margin. Hair sparse and very short, the dorsocentral hairs and bristles black. Scutellum appearing partly brown in some views, without hair or bristles. Pronotum brown above; metanotum golden brown dorsally; pleura white, the posterior border broadly yellowish, in front with a broad brown band extending from behind the humeri to behind the front coxae; hair white.

Legs yellowish, the anterior four ferruginous above, the tibiae broadly reddish yellow apically; tarsi reddish, becoming brown apically; spur of front tibia brown on apical half.

Wings with luteous tinge, slightly darkened apically. Halteres reddish with brown knob.

Abdomen shining ferruginous, the second and following segments each with a brownish or blackish lateral stripe and the apices more or less darkened. Genitalia dark reddish.

HOLOTYPE.—Female, São Paulo, Brazil (Count A. A. Barbiellini).

It is possible that the lateral blackish markings on the abdomen are due to staining, although some of them appear to be natural.

***Mirolestes facialis*, new species**

Ferruginous, the abdomen with black markings; mesonotum with four narrow reddish brown vittae. Length, about 11 mm.

FEMALE.—Face and frontal orbits golden-yellow pollinose, the sides of the face broadly whitish, the front shining ferruginous; ocellar tubercle brown pollinose. Occiput brownish yellow, becoming gray below, the hair and bristles yellow. Mystax composed of white bristles and hairs. Proboscis black, reddish basally; palpi brown, reddish above toward the apex, their hair black. Antennae brownish red; third segment black on about the apical half, haired above on the basal half, excised at the apical fourth but without distinct spine.

Mesonotum brownish red, bearing four narrow, pale brown vittae, the median pair approximate, obsolete behind, the outer ones weakly interrupted at the suture; scutellum discolored but probably paler than the mesonotum. Mesonotal hair and bristles black. Pleura whitish pollinose, in part with yellow tinge, anteriorly with the usual broad brown band; hair and bristles yellow.

Legs brownish red, the femora and tibiae more yellowish ventrally, the tarsi becoming black apically; spur of front tibia almost all ferruginous. Tibial bristles almost all yellowish, those on the tarsi mostly black; femora almost bare.

Wings almost hyaline, the apex somewhat grayish. Halteres yellow with brown knobs.

Abdomen somewhat discolored, ferruginous with the sides rather broadly black, the dark color produced broadly inward toward the bases of the segments and almost wholly covering the disc of the second and the broad base of the third segments; ninth segment black except for a broad median dorsal line; genital hooks ferruginous.

HOLOTYPE.—Female, São Paulo, Brazil (Count A. A. Barbiellini).

Mirolestes pleuralis, new species

Ferruginous, the face wholly dark golden-yellow pollinose; mesonotum with four weak brown vittae. Length, 14 mm.

FEMALE.—Face and sides of the front with dark golden-yellow pollen, the occiput brownish-red pollinose, grayish below, paler along the orbits; front shining dark reddish, the ocellar tubercle with brownish-yellow pollen; occipital hair rather strong, yellow, one or two of the upper occipital cilia black. Mystax with yellow hairs and one or two pairs of yellow bristles. Proboscis shining black, the basal third reddish yellow below. Palpi reddish with black base and hair. Antennae reddish; third segment mostly brown, haired on the upper surface to beyond the middle, at the apical sixth with a small spine followed by a shallow excision.

Thorax rich brownish-yellow pollinose, the pleura with lighter areas in the middle and a broad brownish band anteriorly; mesonotum with four rather weak, narrow brown vittae, the median pair approximate and obsolete posteriorly, the outer ones distinctly interrupted at the suture. Hair very sparse, black dorsally, pale on the pleura.

Legs reddish, the apical segment of the anterior four tarsi brown; bristles reddish yellow, black on the tarsi; spur of front tibia mostly brown.

Wings hyaline with luteous tinge. Halteres yellow with brown knob.

Abdomen shining dark reddish, the sides and apices of the segments more or less blackish. Ninth segment mostly reddish, black at the apex and on the sides.

HOLOTYPE.—Female, São Paulo, Brazil (Count A. A. Barbiellini).

ALLOPOGON Schiner

The following key includes the species occurring in Brazil and Uruguay.

TABLE OF SPECIES

- | | |
|---|-------------------------------|
| 1.—Wings hyaline, at most slightly darkened apically..... | 2. |
| Wings brown on the basal third | <i>basalis</i> , n. sp. |
| 2.—Mesonotum with three or four reddish or brownish vittae..... | 3. |
| Mesonotum whitish, with five reddish vittae..... | <i>tessellatus</i> Wiedemann. |
| 3.—Hair and bristles of the head whitish..... | 4. |
| Hair and bristles of the head black..... | <i>dimidiatus</i> , n. sp. |
| 4.—Antennae reddish..... | <i>necans</i> Wiedemann. |
| Antennae brown..... | <i>vittatus</i> Wiedemann. |

Allopogon basalis, new species

Wings broadly brown basally; abdomen orange, white from basal view, the sides with black spots. Length, 12 mm.

MALE.—Front, occiput above the neck and upper three-fourths of the face yellow in ground color, silvery-white pollinose; face brownish on the lowest third or slightly more. Occiput brown, in some views wholly white pollinose. Front with a few hairs above and on the sides; one pair of strong ocellar bristles; three pairs of oral bristles, the lateral pair weak. Palpi brown, black-haired. Antennae orange. Hair on the head wholly black.

Dorsum of the thorax reddish in ground color, whitish pollinose, the disc of the mesonotum with olivaceous tinge; scutellum and metanotum with yellowish pollen. Hair very short, black, the bristles black; one or two pairs of strong dorsocentrals. Pleura brown, broadly pale in ground color and white pollinose above in front of the wings, the hair and bristles black. There are indications of a pair of narrow brownish vittae on the front of the mesonotum.

Legs shining reddish, the tarsi black with the first segment almost all yellow; femora basally and the tibiae toward their apices more or less ferruginous. Coxae brown.

Wings light brown on the basal third, hyaline beyond.

Abdomen yellowish red above, white pollinose from basal view; each segment with a rather quadrate black spot on either side covered with brown pollen. Venter black, brown pollinose. Genitalia shining reddish. Abdomen bare dorsally except at the tip, the venter with fine brown hair; genitalia with coarse black hair.

HOLOTYPE.—Male, Brazil.

***Alloponon dimidiatus*, new species**

Ferruginous and blackish, the apical half of the abdomen white from basal view. Length, 12.5 to 15 mm.

MALE.—Occiput above the neck, front and face reddish in ground color, densely white pollinose; occiput black, white pollinose; cheeks shining brown; hair and bristles wholly black. Front with sparse hair on the upper half; ocellar bristles rather weak. Palpi shining brown. Antennae reddish, the third segment with brown tinge.

Thorax reddish in ground color, practically all pollinose. Mesonotum with very pale shining yellowish pollen having an olivaceous tinge on the disc; with four brown vittae, the median pair approximate and extending to the posterior fourth, the outer ones extending from the anterior fourth almost to the scutellum, interrupted at the suture; pronotum and broad upper border of the pleura in front of the wings whitish pollinose, the scutellum and metanotum with pale brassy-yellow pollen; pleura brown pollinose. Hair and bristles wholly black.

Legs reddish yellow, the femora more or less ferruginous basally; coxae brown and clothed with brown pollen; tips of the tibiae and the apical tarsal segments brownish.

Wings hyaline, the apical sixth, and the posterior margin on the apical half grayish.

Abdomen blackish in ground color, the apices of the segments increasingly broadly reddish, the eighth segment with the dorsum wholly red; second to fourth segments dull black with the apices and sides white pollinose, the third with the base very broadly whitish, the fifth and following segments rather silvery-white pollinose. Genitalia reddish, black haired. Abdomen with short, coarse black hair dorsally and fine brown hair on the brown pollinose venter.

FEMALE.—The dark mesonotal vittae may be ferruginous and the lower border of the pleura is paler than the brown middle band. Abdomen rusty reddish with a large black spot on each side of the first six segments, the dark spots followed by silvery-white pollinose spots; apical segments yellow pollinose laterally, shining dorsally the remaining segments with rusty-reddish pollen dorsally, the apices of the segments pale.

Types.—Holotype, male and allotype, female, Rio de Janeiro, Brazil, November. Paratypes, four males and one female, Rio de Janeiro (Williston Collection).

LASTAURINA Curran

The type of this genus is *Dasyopogon ardens* Wiedemann. In the male all the abdominal segments bear bands of bright reddish-yellow pile.

ATOMOSIA Macquart

Since the publication of the key to the species belonging to this genus, Dr. Bromley has described a number of species from Cuba, and four others have come to my attention. A new key, enlarged to include all the species that have been sufficiently well described is given below.

TABLE OF SPECIES¹

- 1.—Border of scutellum with two or four bristles on the margin 4.
Border of scutellum with six or more marginal bristles. 2.
- 2.—Six or seven marginal bristles on the scutellum 3.
Border of scutellum with bristly hairs on the entire margin (Argentina).
venustula Arribalzaga.
- 3.—Mesonotum with very short white hair (Cuba) *pubescens* Bromley.
Mesonotum with very short yellowish and blackish hair.
Aphestia andrenoides Bromley.
- 4.—Anterior femora and tibiae not wholly pale yellow. 5.
Anterior femora and tibiae wholly pale yellow. 25.
- 5.—Posterior tibiae and tarsi with dense silvery hair. 6.
Posterior tibiae without dense silvery hair dorsally. 7.
- 6.—Two ocellar bristles. *tibialis* Macquart.
Four or six ocellar bristles (Colombia) *argyrophora* Schiner.
- 7.—No longer dorsocentrals among the appressed hair of the mesonotum. 8.
Dorsocentral hairs or bristles always present. 9.
- 8.—Collar with very stout bristles. *armata* Hermann.
Collar with fine hair. *nuda* Hermann.
- 9.—Thorax and abdomen metallic bronze-green. *metallescens* Hermann.
Thorax and abdomen black. 10.
- 10.—Hair of face and palpi wholly or mostly black. 11.
Hair of face and palpi yellow or white. 14.
- 11.—Oral margin very broadly bordered with shining black. *melanopogon* Hermann.
Oral margin pollinose. 12.
- 12.—Face golden brown, whitish above the oral margin. *barbiellinii*, n. sp.
Facial pollen white. 13.
- 13.—Mesopleura wholly pollinose (Cuba) *parva* Bigot.
Mesopleura mostly shining black. *selene*, n. sp.
- 14.—Scutellum with two bristles. 15.
Scutellum with four bristles. 18.

¹*A. cerverei* Bromley, from Cuba, is omitted.

- 15.—Mesopleura wholly pollinose.....*danforthi*, n. sp.
 Mesopleura partly shining black.....16.
- 16.—Mesonotum and scutellum with yellowish hair.....17.
 Mesonotum and scutellum with white hair.....*glabrata* Say.
- 17.—Femora wholly black or with only the tips reddish.....*incisuralis* Macquart.
 Femora with the bases broadly reddish.....*rica*, n. sp.
- 18.—Ocular tubercle with at most four bristles.....20.
 Ocellar tubercle with six or more bristles.....19.
- 19.—Ocellar tubercle with six bristles.....*setosa* Hermann.
 Ocellar tubercle with numerous bristles.....*beckeri* Jaenicke.
- 20.—Posterior femora reddish with the apical half black.....21.
 Posterior femora blackish with only the base and apex reddish brown.....22.
- 21.—Front above and middle of face brownish-golden pollinose (Brazil).
frontalis Curran.
 Front and face white pollinose.....*glabrata* Say.
- 22.—Vertex shining black.....*geniculata* Wiedemann.
 Vertex with ochreous pollen.....23.
- 23.—Face golden yellow.....*macquarti* Bellardi.
 Face white.....24.
- 24.—Ocellar tubercle with two black bristles and two white hairs.
melanopogon Hermann.
 Ocellar tubercle with only the two black bristles; apical tarsal segment black-haired.....*puella* Wiedemann.
- 25.—Tarsi wholly black or brown.....26.
 At least the basal two segments of the tarsi not black.....29.
- 26.—Posterior calli yellow.....*nigra* Bigot.
 Posterior calli black.....27.
- 27.—Abdomen blackish.....28.
 Abdomen dark metallic-blue (Cuba).....*metallica* Bromley.
- 28.—Posterior tibiae practically all black; basal antennal segments reddish brown (Cuba).....*maestrae* Bromley.
 Posterior tibiae yellow on the basal half; antennae wholly blackish (Panama).
panamensis Curran.
- 29.—Ocellar tubercle with two bristles.....30.
 Ocellar tubercle with six or more bristles.....*anonyma* Williston.
- 30.—Posterior calli partly or wholly reddish yellow.....32.
 Posterior calli black.....31.
- 31.—Posterior tibiae wholly yellow (N.A.).....*sayi* Johnson.
 Posterior tibiae broadly black at apex.....36.
- 32.—Apical three segments of posterior tarsi, and apical third of hind tibiae, brownish.
 the femora wholly pale.....36.
 Only the apical segment of the tarsi brown.....33.
- 33.—Posterior femora brownish apically.....*soror* Bigot.
 Posterior femora wholly reddish or yellowish.....34.
- 34.—Posterior tibiae wholly yellow.....*mucida* Osten Sacken.
 Posterior tibiae with apex broadly brown.....35.
- 35.—Mesonotum without long hair.....*bequaerti* Bromley.
 Mesonotum with long hairs.....*punctifera* Hermann.

36.—Front shining black on median third for the whole length (Brazil).

coxalis Curran.

Front pollinose on anterior half or with a linear median shining vittae. 37.

37.—Apical two or three tarsal segments brownish. 38.

Only the apical tarsal segment brownish. *rufipes* Macquart.

38.—Posterior calli wholly black. 39.

Posterior calli reddish yellow. *eupoda* Bigot.

39.—Posterior femora black on apical third (Brazil). *tenuis* Curran.

Posterior femora wholly reddish yellow (Brazil). *lineata* Curran.

Atomosia barbiellini, new species

Related to *parva* Bigot, but the face is golden brown on more than the upper half and the mesopleura is mostly shining. Length, 7 to 8 mm.

MALE.—Front cinereous pollinose, the vertex reddish brown; ocellar swelling black, bearing one pair of black bristles and some short white hairs, the frontal hair black. Occiput reddish-brown pollinose above, cinereous below, the hair white, yellow above, the bristles yellow. Face golden brown, becoming cinereous on the lowest fourth; hair and bristles whitish along the oral margin, black above. Proboscis and palpi white-haired. Antennae black; third segment one-fourth longer than the basal two, excised and with a small spine a little beyond the middle.

Mesonotum and scutellum shining black, thickly clothed with very short, pale brassy-yellow hairs, the bristles of the same color, the notopleural bristle and the weak dorsocentrals black; scutellum with two pairs of short bristles. Pleura with yellowish-cinereous pollen, the mesopleura mostly bare; hair white.

Legs black, the coxae cinereous pollinose; femora with the narrow bases and tips reddish, the posterior pair with the basal fifth reddish. Anterior four tibiae on the basal fourth and the posterior pair on the basal two-thirds reddish. Hair white, the bristles yellowish to ferruginous, partly black on the tarsi; tarsi black-haired above.

Wings cinereous hyaline with brownish tinge; anterior cross-vein situated slightly beyond the middle of the discal cell; apical cell widely open. Halteres reddish yellow.

Abdomen slightly shining black, clothed with short brown hair, the hair on the sides yellowish; tips of the segments whitish pollinose, the pollen limited to the sides on the second segment. Venter brown, with dull yellowish hair.

FEMALE.—Oral bristles black, the hair white; bristles on the sides of the mesonotum black; anterior femora reddish on the under surface on their whole length, the middle pair incompletely reddish below; basal third of the posterior femora reddish; anterior four tarsi white-haired above; wings without brown tinge; sixth and seventh abdominal segments broadly yellow-haired laterally, the abdominal hair shorter.

Types.—Holotype, male, and allotype, female, São Paulo, Brazil (Count A. A. Barbiellini). Paratype, female, Rio de Janeiro (H. Sousa Lopes).

Atomosia selene, new species

Related to *parva* Bigot, but the mesopleura is more than half shining black. Black, coarsely punctured, the head and pleura whitish pollinose. Length, 9.5 mm.

FEMALE.—Head whitish pollinose, the ocellar tubercle shining black; two or three pairs of yellowish ocellar bristles and several hairs; occiput above and the

vertex with brownish yellow pollen, the pile white. Face with black bristles and hairs. the hair on the upper half white; frontal bristles black. Proboscis and palpi white-haired, the palpi with several black apical bristles. Antennae black, the third segment brownish, twice as long as the basal two, excised and bearing a small spine at the apical third above.

Mesonotum and scutellum shining black, the pile very short and appressed, pale brassy yellow, paler anteriorly; bristly dorsocentral hairs black, the bristles ferruginous. Scutellum with two pairs of bristles. Pleura, except most of the mesopleura, whitish pollinose and pilose. Collar with yellowish tinged hair.

Legs black, the coxae white pollinose and pilose; tips of the femora, the broad bases of the anterior four tibiae and more than the apical half of the posterior pair reddish, the posterior femora narrowly reddish at the base. Hair and bristles white, the tarsal bristles ferruginous; posterior tarsi wholly black-haired above, the middle pair with the apical two segments black-haired.

Wings cinereous hyaline, the anterior cross-vein situated at the middle of the discal cell; apical cell open or closed in the wing margin. Halteres yellow.

Abdomen shining black, with very short black hair, the apices and sides of the segments with white hair, the terminal segment wholly pale-haired; narrow tips of the second to sixth segments white pollinose, the pollen broadly interrupted on the second to fourth segments, on the second limited to the sides. Venter brownish with whitish hair.

HOLOTYPE.—Female, São Paulo, Brazil (Count A. A. Barbiellini).

Atomosia danforthi, new species

Black, the legs partly yellowish; mesonotum with yellow hair; mesopleura wholly pollinose. Length, 6 mm.

MALE.—Face and lower part of the occiput white pollinose; occiput mostly cinereous, the front brownish-yellow pollinose; hair and bristles white, only one pair of black ocellar bristles; ocellar tubercle shining black. Palpi with black hair. Antennae black, with black hair and bristles; third segment one-fourth longer than the basal two combined, excised and bearing a spine near the apical third.

Mesonotum and scutellum shining black, with very short brassy-yellow hair, the bristles black or yellowish; scutellum with one pair of yellow marginals. Pleura wholly cinereous pollinose, with yellow tinge above, the hair and bristles white.

Legs black, the coxae cinereous pollinose; femora with the basal fourth and apical fifth reddish, the anterior four more or less reddish on the whole length beneath; tibiae reddish on almost the basal two-thirds; hair white, black on the apices of the tibiae and on the tarsi, the tibial bristles mostly black; trochanters reddish except at the apex.

Wings cinereous hyaline, with brownish or luteous tinge; apical cell closed and short petiolate; anterior cross-vein situated distinctly before the middle of the discal cell. Halteres yellow.

Abdomen shining black, the apices of the third to sixth segments white pollinose, the pollen broadly interrupted on the third and fourth segments, and limited to small spots on the second. Hair brownish yellow, black on the apical two segments except on the lateral marginals. Venter brownish, pale-haired.

FEMALE.—The bristles on the femora and tibiae are white and the anterior four tarsi are white-haired above.

Types.—Holotype, male, and allotype, female, Coamo Springs, Porto Rico, November 9, 1930 (S. T. Danforth).

***Atomosia rica*, new species**

Black, the legs partly yellow; mesonotum yellow-haired; mesopleura mostly shining black. Length, 6.5 to 8 mm.

MALE.—Front cinereous pollinose, the ocellar tubercle shining black and bearing one pair of black bristles; occiput golden brown, becoming white below; face white pollinose; hair and bristles white, black on the palpi and antennae but wholly white on the under side of the first segment of the latter. Antennae black, the third segment excised and bearing a spine at the apical third, one-third longer than the basal two combined.

Mesonotum and scutellum shining black, with short brassy-yellow hair, the sides of the former narrowly cinereous pollinose; bristles black, those on the posterior calli and the single scutellar pair yellow. Pleura cinereous white pollinose, the mesopleura with a large, orbicular shining spot in the middle; hair and bristles white.

Legs black, the coxae cinereous pollinose; trochanters mostly reddish yellow; femora with the basal fifth reddish yellow, the posterior pair yellowish on the basal fourth, the anterior pair more or less reddish on the whole length below, the apices of all the femora broadly reddish; tibiae with about the basal fourth reddish yellow; basal segment of the tarsi reddish except apically, the hind ones reddish only basally. Hair and bristles white, the anterior tarsi black-haired above.

Wings cinereous hyaline; apical cell open; anterior cross-vein at the middle of the discal cell. Halteres yellow.

Abdomen shining black; third to sixth segment with linear apical white pollinose fascia, the second with a small lateral white spot; hair white. Venter grayish.

FEMALE.—Anterior four legs missing; the posterior femora are broadly reddish at the apex.

Types.—Holotype, male, Mayaguez, Porto Rico, September 1, 1931; allotype, female, Las Marias, Porto Rico, May, 1931 (S. T. Danforth).

PROMACHINA Bromley

As pointed out by Dr. Bromley, this genus is intermediate between *Promachus* Loew and *Mallophora* Macquart, differing from the former in having the claws blunt and from the latter by its more slender build and narrow face and front. The typical species of *Promachina* have the face only gently swollen below and bear hair on the upper portion. A second group more closely resembles *Erax* Scopoli in having the face more gibbous below and without hair above, the genitalia resembling *Erax*. It is possible that a new genus should be erected for this latter group but, until more is known concerning the many described species of *Erax* from the Neotropical region, it seems unwise to propose a new genus.

It is possible that a number of described species at present placed in the genera *Asilus*, *Erax*, *Promachus*, and *Mallophora* belong in *Pro-*

machina, but this can only be determined by an examination of the types. Several of the species known to belong to *Promachina* agree well with species of *Erax* and *Promachus* in general coloration and it is impossible to be certain of the identity of the various forms. All the species known to me are included in the following key.

TABLE OF SPECIES

- 1.—Legs wholly black in ground color.....2.
 Legs in part yellowish or reddish.....4.
- 2.—Face rather strongly gibbous below, without hair on the upper third.....3.
 Face but little swollen below, with hair below the antennae...*nigripes* Fabricius.
- 3.—Wings gray on the apical seventh only in front of the fourth vein.
 neovillistoni Bromley.
 Wings mostly grayish on the apical half.....*eraxoides*, n. sp.
- 4.—Front tibiae black.....5.
 Front tibiae at least partly reddish or yellowish.....6.
- 5.—Abdomen with band of white pile on the second segment. ♀, *annularis* Fabricius.
 Abdomen with golden-yellow pile.....*pulchellus* Bellardi.
- 6.—Scutellum with black pile.....7.
 Scutellum with white or yellowish pile.....8.
- 7.—Abdomen with golden yellow pile.....♀, *annularis* Fabricius.
 Abdomen black, with a band of long white hair near the base.
 trichonotus Wiedemann.
- 8.—Scutellar pile almost or quite as long as the dorsocentral bristles.....9.
 Scutellar pile short and not very conspicuous.....10.
- 9.—Dorsum of the abdomen with black hair.....*barbiellinii*, n. sp.
 Abdomen with yellowish hair, toward the apex often with some black hair.
 trapezoidalis Bellardi.
- 10.—Scutellum with one pair of bristles; male genitalia wholly black-haired.
 pulchripes Bromley.
 Scutellum without bristles or they are extremely weak; male genitalia with
 golden hair at base of under surface.....*proquinquus* Bromley.

***Promachina eraxoides*, new species**

A small species resembling certain species of *Erax* in appearance but with blunt claws. It is closely related to *neovillistoni* Bromley, described in *Erax*, but differs in having the wings much more extensively gray and in the male genitalia. The females can be separated only by the more extensively grayish wings. Length, 9 to 14 mm., exclusive of ovipositor.

MALE.—Head black, cinereous-white pollinose, the face and front yellowish or brownish yellow; front with black hair; occipital cilia black; beard white. Mystax black, yellow on the lower half, composed almost entirely of bristles. Proboscis and palpi black, the latter with black hair on the apical half. Antennae black, with black hair; third antennal segment elongate oval, as long as the basal two segments combined; arista slightly longer than the third segment.

Thorax black, cinereous-white pollinose, the black vittae very wide, separated by a line of pale pollen, all broadly separated from the posterior border, the median one

divided by a whitish line. Hair sparse, black, white on the scutellum and pleura; one pair of scutellars; three or four pairs of dorsocentrals; some of the hypopleural bristles black.

Legs wholly black, clothed with appressed pale-yellowish hair; bristles mostly black, partly pale on the femora; tarsal hair mostly black.

Wings hyaline, with luteous tinge, grayish on almost the apical half. Halteres yellowish.

Abdomen with the sides, eighth segment wholly and the rather broad posterior borders of the preceding segments, whitish; seventh segment reddish brown, the preceding two segments more or less brown pollinose medianly; hair black dorsally, white on the sides and on the gray pollinose venter. Genitalia shining black, the lower surface densely clothed with tawny hair except on the apical half of the upper forceps, the tawny pile on the forceps bordered by black bristles; the upper forceps are produced at the lower apex and bear a long, digitate process before the upper apex, the hair brownish.

FEMALE.—Mystax with some black bristles laterally; seventh abdominal segment cinereous pollinose on the apical half; main section of the ovipositor not quite as long as the preceding three segments.

TYPES.—Holotype, male, and allotype, female, Chapada, Brazil. Paratypes, three males, Chapada (Williston Collection).

I have before me another species represented by several females having the ovipositor much longer and the seventh abdominal segment pollinose on the apical third or less. Their description must await the discovery of males.

This species, together with *neouillistoni*, *pulchripes*, and *propinquus*, all described by Dr. Bromley in the genus *Erax*, might well be placed in a different genus, since they differ from the typical forms in having the face more swollen and the absence of hairs above, more elongate ovipositor and somewhat different venation.

***Promachina barbiellinii*, new species**

Black, yellowish and black-haired, the legs mostly reddish. Related to *trapezoidalis* Bellardi but the abdominal segments are wholly black-haired dorsally, the yellow hair being limited to the sides. Length, 18 mm.

MALE.—Front with brown pollen and black hair. Pollen of the occiput golden brown above, becoming grayish below, the pile pale yellow below, darker above, the bases of the bristles brown. Face and cheeks with rather golden-yellow pollen and reddish-yellow hair, a few fine black bristles near the antennae. Proboscis and palpi black, the latter with black bristly hair apically. Antennae black, with black bristles, the first segment with yellowish hair below; third segment about three times as long as wide; arista longer than antenna.

Mesonotum rich brown pollinose, with four darker brown vittae, from posterior view wholly reddish brown; hair black, white on the sides behind the suture and pale yellowish on the scutellum. Pleura brownish red, becoming cinereous below, particularly toward the hind margin; hair pale yellowish. Pronotum with pale pile, at most a few black bristles dorsally.

Legs shining reddish, the anterior four femora black anteriorly, the posterior pair black anterodorsally on the apical half; coxae cinereous pollinose and pale yellow pilose. Anterior four femora black-haired in front, whitish haired behind; posterior femora black-haired in front and on most of the apical half, but with a pale-haired stripe extending almost to the apex on the anterior and posterior surfaces. Tibiae black-haired, with yellow hair on posterior surface, the posterior pair with white hair intermixed with the black on the basal half. Tarsi wholly black-haired.

Wings pale brownish, darker on the apical fourth in front. Halteres reddish yellow.

Abdomen dull black, on the sides with more or less subtriangular cinereous-brown triangles that reach the bases of the segments, the spots on the apical segments almost rectangular; dorsum clothed with short, rather sparse, appressed black hair, the sides with moderately long pale yellow pile, the second segment almost all pale-haired. Venter cinereous-yellow pollinose and pale-haired. Genitalia, shining, reddish, the upper forceps bordered with black, hair wholly black.

HOLOTYPE.—Male, São Paulo, Brazil (Count A. A. Barbiellini).

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THE TAHITIAN BLACK MARLIN, OR SILVER MARLIN SWORDFISH

By J. T. NICHOLS AND F. R. LAMONTE

In preparing an article on marlin swordfish (*Makaira*) for 'Natural History,' we find that the so-called "silver marlin" caught in Tahitian waters represents a recognizable undescribed form.

***Makaira nigricans tahitiensis*, new subspecies**

DESCRIPTION OF TYPE.—A specimen caught at Tahiti, July 24, 1931, by Eastham Guild, of which we publish a photograph (p. 2).

Total length, 11 ft. 9.5 in.; girth, 5 ft. 2 in.; caudal spread, 47 in.; weight, 504 lbs. (Guild). Depth (greatest at shoulder) in length from front of eye to base of caudal, 3.9; head without snout, 6.5; caudal spread, 2. Dorsal height (origin to tip) in head without snout, 1; anal height, 1.2; eye, 5.6. Head without snout, in snout and spear (from eye), 2.2. Spear short and stout; pectoral falcate, first dorsal and anal falcate, with firm, pointed lobes. Color uniform, and pale for a black marlin.

The photograph of a larger (record) specimen kindly sent us by its captor, Zane Grey, who concurs in our opinion that this is a distinct and undescribed form, confirms the characters shown by the type. It was taken at Tahiti in March 1930 and weighed 618 pounds (Grey). Corresponding measurements are: depth in length, 3.7; head, 6. Dorsal height in head, 1.4; anal, 1.4; eye, 7. Head in snout and spear, 1.7.

The falcate fins, stout spear, and lack of bold markings, place this form with the black marlin; the great depth, paler color and, if it holds, very wide caudal spread separate it from the black marlins of Lower California and of New Zealand which we have been unable to differentiate from one another satisfactorily. It seems from photographs to be a more compressed fish than they.



Fig. 1. *Makaira nigricans tahitiensis*, type.

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BEES FROM ERITREA, NORTHWEST AFRICA

By T. D. A. COCKERELL

In 1930, Mr. H. Compere collected a few species of bees in Eritrea, and through the kindness of Mr. P. H. Timberlake these have been handed to me for study. All the species, including the holotypes, will be found in the American Museum.

Anthophora bipartita comperei, new subspecies

FEMALE.—Length about 16 mm.; exactly like *A. bipartita* Smith, with the anterior part of thorax above black-haired, but the very rugose clypeus entirely black, with a strong median keel on upper half.

Nefasit, April 16. This is entirely parallel with *A. nigroclypeata* (Friese), which is a similar black-faced form related to *A. flavicollis* Gerstaecker. True *A. bipartita* comes as far north as Nairobi.

Trigona beccarii Gribodo

Six from Martini's Concession, March 23. They were found on orange blossoms.

Trigona bottegoi Magretti

Six from Martini's Concession, March 23. Found on orange blossoms.

Ceratina citriphila, new species

FEMALE.—Length about 7 mm.; robust, dark greenish-blue, including tubercles, but disc of mesothorax black; flagellum dusky reddish beneath except at base; clypeus with a very broad dull yellow longitudinal band, somewhat broadened below, but with only traces of lateral extensions; head and thorax densely and strongly punctured, the disc of mesothorax dull in middle, with punctures running in lines, but there is a pair of shining bands, on which are few punctures; prothorax with a slender fringe of white tomentum; scutellum with a shining dot in middle, but no line; axillae briefly spined; tegulae very small, shining black; wings brownish hyaline, stigma dark reddish; legs mainly black, but front femora green, front tibiae with a cream-colored stripe on basal half, hind tibiae with the basal half creamy white on outer side, hind basitarsi dull whitish on outer side; abdomen strongly punctured, tergites not ciliate; last tergite very rugose, with a subapical elongate pit; sternites shining blue with black margins.

Two specimens from Martini's Concession, March 23, on orange blossoms.

In the series of females with dark tubercles (without the light spot), and having the hind tibiae with a large light mark, this species falls as follows.

- 1.—Disc of mesothorax green; hind basitarsi with a pale mark; clypeal mark yellowish white, with long lateral extensions (Belgian Congo) . . . *albopicta* Cockerell.
Disc of mesothorax blue; blue species with spined axillae; hind basitarsi with no pale mark. *pileifera* Cockerell, variety.
Disc of mesothorax black. 2.
- 2.—Abdomen rich purple-blue (S. W. Africa). *turneri* Cockerell.
Abdomen not so colored. 3.
- 3.—Abdomen olive green, with brassy tints; wings dusky; hind basitarsi all black.
viridifrons Cockerell, variety.
Abdomen bluish green to steel blue. 4.
- 4.—Stigma pale dull brown; wings grayish; hind basitarsi dark; scutellum with a smooth band in middle (Pemba Island) *pembana* Cockerell.
Larger (about 7.5 mm.) and blue instead of green; clypeal mark very broad, with lateral extensions at lower end; wings and stigma darker. . . *pileifera* Cockerell.
Very like the last, but greenish; clypeal mark without distinct lateral extensions, and much narrower at upper end. *citriphila*, n. sp.

C. pileifera (described in a paper awaiting publication) is variable, or perhaps composite. The types (both sexes) come from Beira, Portuguese East Africa (A. Mackie, J. Ogilvie), but other specimens, showing variation, are from Tanganyika Territory and the Belgian Congo. *C. citriphila* is a darker and different looking insect, and must, I think, be treated as a different species. It resembles *C. fastigiata* Fox, but is easily separated by the dark tubercles.

Allodape taita Strand

FEMALE.—Length about 7 mm., anterior wing about 4; shining black, with clypeal mark (but no lateral marks) and tubercles cream-color; tegulae hyaline; wings hyaline, iridescent, with very large dark brown stigma and dark nervures; eyes dark red; mandibles black; upper part of clypeus pale yellow right across, the yellow here forming a quadrate area about twice as broad as long; the lower part of the clypeus has a central band, the whole mark with the outline of a mallet; antennae black, the flagellum faintly brownish beneath; a little semicircular white mark on second antennal joint, and extremely small marks on end of scape and on third joint, or all these white marks may be absent; ocelli red; mesothorax highly polished; second cubital cell receiving recurrent nervures about equally distant from end; legs black, with small joints of tarsi light red; spurs yellowish white; abdomen with the basal half shining, the apical half dull, tergites 4 and 5 with linear pallid margins.

Two specimens from Martini's Concession, March 23, on orange blossoms.

In Strand's table (1914) this runs to *A. taita* Strand, which is about 6 mm. long. The description agrees so well with our insect that I feel confident that the identification is correct. *A. taita* is recorded from various localities of East Africa.

***Allodape citrifloris*, new species**

FEMALE.—Length, 4 mm.; black, with the clypeus yellowish white, the light area constricted in middle; no lateral marks; labrum, spot on base of mandibles, scape in front, and tubercles, all yellowish white; flagellum dark reddish beneath; mesothorax highly polished; tegulae pale testaceous, and wing-base conspicuously pale, with a white dot; wings clear hyaline, with a very large reddish-brown stigma, and pale nervures; second cubital cell short, quadrate, receiving second recurrent nervure far from end; first recurrent joining first cubital cell a short distance from end (on one side there is an abnormal, oblique nervure crossing first discoidal cell); trochanters and femora black, tibiae and tarsi pale red; abdomen shining, obscurely brownish, tergites 3 to 5 with pallid margins. The hind tibiae are somewhat dusky.

One specimen from Martini's Concession, March 23, on orange blossoms.

In Strand's table (1914) this runs to *A. pembana* Strand, agreeing in the small size, but differing in the venation and the pallid tibiae. In Friese's table (1924) it comes nearest to *A. albitarsis* Friese, described from Eritrea, but that species has the tibiae black, brown at end.

***Allodape comperei*, new species**

FEMALE.—Similar to the last, but 4.75 mm. long; lateral constrictions of light clypeal area very shallow; first recurrent nervure joining second cubital cell very near base, second very far from apex; labrum and base of mandibles dark. The tibiae and tarsi are chestnut red, and the long ample wings are very faintly brownish.

One specimen from Martini's Concession, March 23, on orange blossoms.

Near to *A. pembana* Strand, from Pemba Island, but larger, the wings 3.9 mm. long (3 mm. in *C. pembana*), and the scape has a white stripe in front (all black in *pembana*), and the red tibiae also at once distinguish it. In Friese's table (1924) it runs to *A. bouyssoui* Vachal, from the French Congo and Angola, but that has rufotestaceous mandibles. The intercubital and recurrent nervures are practically colorless. The mandibles have a brown band across the middle, and the labrum is obscurely brownish. The area of metathorax is microscopically transversely lineolate.

As there is no key to Vachal's African *Allodape*, I made one from the descriptions. In no case is the abdomen red.

- 1.—Without yellow markings.....2.
Marked with yellow.....4.
- 2.—Entire clypeus (female) reddish; length, 6.5 mm. (Belgian Congo).....*neavei*.
Clypeus not reddish (females).....3.
- 3.—Tegulae red; length, 4.5 mm.....*pulla*.
Tegulae hyaline; length, 6.5 mm. (Delagoa Bay).....*vitrea*.
- 4.—Larger; 6.5 mm. or over; females.....5.
Smaller; 6 mm. or less.....6.
- 5.—A broad interrupted line in middle of clypeus; length, 6.5–8 mm. (French Congo).....*interrupta*.
(If pronotum and tubercles yellow, from Sierra Leone, var. *collaris*.)
Clypeus with a T in yellow; length, 6.5–7 mm. (French Congo and Belgian Congo).....*nigricollis*.
- 6.—Males.....7.
Females.....8.
- 7.—Entire clypeus yellow; tarsi yellow; length, 4.5–6 mm. (French Congo).....*ictis*.
Clypeus marked with yellow; length, 6 mm.....*interrupta*.
- 8.—Legs almost entirely rufotestaceous; length, 5–5.5 mm. (French Congo and Angola).....*bouyssoui*.
Legs not so colored.....9.
- 9.—Clypeus with a thick yellow T; tubercles yellow; length, 5 mm. (Lumbwa, Kenya, alt. 6340 ft.).....*leptozonia*.
Clypeus with a yellow T on a shuttle; labrum yellow; length, 4.5 mm. (French Congo).....*rolini*.
Clypeal mark narrowed above; tubercles yellow; length, 4.5–6 mm.....*ictis*.

***Halictus simulator*, new species**

FEMALE.—Length about 8 mm., anterior wing 6; black, including mandibles, antennae (apical part of flagellum very faintly brownish beneath), and tegulae; pubescence white; wings hyaline and iridescent, the large stigma dark reddish, nervures mostly light brown, basal nervure black; face rather narrow; clypeus moderately produced, shining, with strong irregular punctures, and a subapical median pit; supraclypeal area convex and polished; front dull; face with thin dull white hair; cheeks broad, with white hair; mesothorax dull, with a median depression, on each side of which it is slightly shining; tubercles with a grayish-white fringe; scutellum with two shining bosses, and a dull interval between; area of metathorax semilunar, with dense strong rather wrinkled plicae; sides of posterior truncation not sharply defined; postscutellum with much white tomentum, and a line of white hair on each side behind axillary region; basal nervure falling some distance short of nervulus; second cubital cell very large, quadrate, somewhat broader than high, receiving the first recurrent nervure very near the apical corner; third cubital cell not or hardly wider than second, the outer nervure pale; legs black, the tarsi red at extreme tip, a little red brush at end of hind basitarsi; hind tibial spur with short oblique sawlike teeth; abdomen broad, moderately shining, the first tergite microscopically, very densely, lineolate and tessellate; tergites with entire rather dull white basal hair-bands, and their margins not discolored.

Two specimens from Nefasit, April 12 (type) and May 15.

Halictus farquhari Cockerell, from Natal, is separated by the red middle and hind tarsi, but the two species are almost exactly alike, and I should think the one from Eritrea a local race, were the locality not so remote.

Halictus nefasiticus, new species

FEMALE.—Length a little over 9 mm., anterior wing 7.3; rather slender, with somewhat the aspect of a male; head and thorax black, including mandibles, but flagellum brown beneath, becoming light red apically; tegulae very dark brown, with traces of very minute punctures; hair of head and thorax abundant and erect, the general effect pale gray, on lower part of mesopleura clear white, on vertex light brown, and partly brown on scutellum, though not on mesothorax; face very broad, inner orbits concave; clypeus dull, finely punctured, obtusely ridged across the middle, with a rather large, shining, round apical pit; mesothorax entirely dull, not depressed in middle; scutellum dull, but the surface is hidden by long hair; metathorax densely hairy except the basal area, which is dull and granular, with weak plicae at base; wings clear hyaline, stigma and nervures light red; basal nervure strongly arched, falling a little short of nervulus; outer nervures pale but not weakened; second cubital cell broad, the lower apical corner somewhat produced, the first recurrent nervure received a moderate distance before the end; third cubital cell, in its widest part, conspicuously broader than second; legs black, with mostly pale hair; hind femora mainly pale reddish, with a very large white scopa; hind tibiae with long curled pure white hair in front, short dark brown hair behind; spurs very pale; hind tibial spur appearing simple, but with a very small low lamina near base, the margin beyond minutely spinulose; abdomen without hair-bands; first two tergites light rufotestaceous, each with a transverse, sharply defined, blackish band; broad apical margins of second and third tergites pallid, of fourth more narrowly so; third tergite with a broad black band before the pale margin, and a pyramidal blackish shade in middle, but otherwise light rufotestaceous; apical part of abdomen black; fifth tergite with a deep apical furrow, extending halfway to base, and bordered by short brown tomentum; venter testaceous basally, apically black; sixth tergite directed forward, at right angles to fifth.

Nefasit, May 15, one specimen.

Related to *H. burunganus* Cockerell, from Burunga, Belgian Congo. That species has the first two tergites similarly colored and marked, but is more robust with rather shining scutellum, flagellum chestnut red beneath, and shorter, yellowish wings.

The following key separates it from related females.

- 1.—Larger and more robust; anterior wing nearly 9 mm.; black band on first tergite enlarged and extending basad at sides. (Burunga, Belgian Congo, J. Bequaert).....*burungensis* Cockerell.
- Smaller and less robust; anterior wing about or a little over 7 mm.; black transverse band on first tergite not enlarged at sides.....2.

- 2.—Black band on first tergite much broader than the marginal region beyond it; first two tergites with broad apical orange bands.

partitus Cockerell (Cape Province).

Black band on first tergite not broader than the marginal area beyond it.....3.

- 3.—Narrow species; tergites 1 to 4 with opaque light yellow marginal bands.

perpansus Cockerell (Natal).

Tergites without such bands.....4.

- 4.—Abdomen broader, third tergite red or pale only at base. *burunganus* Cockerell.

Abdomen narrower, third tergite half pale red..... *nefasiticus*, n. sp.

It can be said of this bee-fauna, as shown by Mr. Compere's collection, that it is entirely Ethiopian in character, with no Palaearctic elements. Also, it has no affinity with the desert fauna of Sudan and Arabia. It may be added that the flora of Eritrea includes, as characteristic genera, *Hyphaene* (palm), *Ficus*, *Albizzia*, *Acacia*, *Bauhinia*, *Cassia*, *Dalbergia*, *Combretum*, *Adansonia*, *Sterculia*, *Strychnos*, and *Sideroxylon*, a characteristically African assemblage.

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PARASITIC BEES OF THE GENUS *COELIOXYs* FROM THE BELGIAN CONGO¹

By T. D. A. COCKERELL

The species of *Coelioxys* may be divided into two groups, *Coelioxys* proper, in which the eyes are hairy, and *Liothyrapis*, in which they are bare.

LIOTHYRAPIS Cockerell, 1911

Two species were found by Lang and Chapin, as follows.

***Coelioxys (Liothyrapis) verticalis* Smith, 1854**

Small females, about 11 mm. long, or less; mesothorax coarsely striate; apical sternite rounded and obtuse at end.

Faradje, twelve, November, December, January, April. Aba, 3° 50' N., 30° 10' E., one, December. On the wide distribution (south to Natal) see Rev. Zool. Bot. Afr., XXIII, 1932, p. 26.

***Coelioxys (Liothyrapis) torrida* Smith, 1854**

Size variable; a large one from Boma is almost 17 mm. long; the smallest one from Faradje only about 11.4 mm.

Stanleyville, March and May; Faradje, November, December, and January; Poko, August; Boma, June. Also taken by J. Ogilvie at Tanga, Tanganyika Territory, and Mozambique, Portuguese East Africa, in June. Thus it extends right across Africa. Friese, in his key to females ('Die Bienen Afrikas'), has this species in the wrong section.

The wide distribution of these insects is remarkable. *C. maculata* Friese, a large species described from the Transvaal, is in the British Museum from Delagoa Bay (collector unknown), and the following places in Uganda: Northern Buddu, 3800 ft., September (S. A. Neave); Kampala, April (C. C. Gowdey); Entebbe, August (Gowdey), and January (Neave). There is also a specimen from F. Smith's collection labelled "W. Africa."

The *C. subdentata* group is even more widely distributed; whether it consists of one species, with local races, or of two or more, is at present uncertain. Smith described it from the male, with ferruginous tarsi,

¹Scientific Results of the Congo Expedition. Entomology No 29.

from the Cape Province. *C. lativentris* Friese, females with the tarsi "rotbraun," appears to be the same species. There is, however, a very widely distributed insect, with dark anterior wings and entirely black legs, which I had regarded as a form of *C. subdentata*, and should not now separate, were it not for the fact that Brauns in 1930 described it as *C. lativentrioides*, giving apparently adequate characters to separate the female from *C. lativentris* Friese, which I suppose to be the female of *C. subdentata* Smith. An older name for this black-legged insect is *C. umbripennis* (*C. decipiens* var. *umbripennis* Friese, 1922), and this must hold, unless (as seems very possible) the *C. cherenensis* Friese, 1913, from Abyssinia should be considered a race of same species. There is also a still older name, *C. neavei* Vachal, 1910, which may be applicable. In the British Museum I find *C. umbripennis* from Matjesfontein, Cape Province (Turner); Fort Jameson (Neave), Upper Luangwa River (Neave), Niamadze River, near Nawalia (Neave), and Chilanga (R. C. Wood), all in N. E. Rhodesia; Kotakota, Nyasaland (J. E. S. Old); Nasisi Hills, twenty miles north of Mumias, British E. Africa, 4800 ft. (Neave); Chiromo, British E. Africa (J. E. S. Old); and the following places in Uganda, North of Lake Isolt, 3700 ft. (Neave): Kafu R., near Hoima, Kampala Road, 3500 ft. (Neave); banks of Nile near Kakindu, 3400 ft. (Neave); between Jinja and Busia or Mbwagos, E. Busoga (Neave). The Matjesfontein females have more white hair on under side of abdomen than those from more northern (north-eastern) regions, but there is no sharp line of division.

From Yapi, Gold Coast, November (J. J. Simpson), comes a distinct subspecies, which I call *C. umbripennis nigriventris*. It lacks (in both sexes) the distinct white hair-bands on under side of abdomen, and the spines of the axillae are remarkably thick and obtuse. The type (to be further described in a paper now being prepared) is a female. Friese described his *C. decipiens* var. *umbripennis* from two females, one from Senegal, the other from Natal. I designate the Natal form as the type, as it resembles *C. decipiens* in having ventral hair-bands on abdomen. It is quite possible that the Senegal one was *nigriventris*, but we have no information on this point.

Apparently *C. maculata* and *C. umbripennis* have spread up and down East Africa, and across to West Africa north of the Equatorial forest, but are not found in the basin of the Congo. No doubt this distribution is connected with that of species of *Megachile* on which they are parasitic.

COELIOXYS Latreille, 1809 (typical subgenus)

Coelioxys (Coelioxys) chubbi Cockerell, 1920

Described from Durban, Natal. Three females taken by Lang and Chapin differ slightly in the yellowish tint of the pubescence, but are positively the same species. They are from Stanleyville, April, and Thysville, June.

There is some affinity with *C. labrosa* Friese, 1914, especially with regard to the hair at end of clypeus (dense and yellowish when fresh), but the shining abdomen, narrower at end, will readily distinguish it.

Coelioxys (Coelioxys) planidens Friese, 1904

Two males from Boma, Belgian Congo, June (Lang and Chapin). The face is very narrow. The species is allied to *C. liberiensis* Cockerell. It was known from the east coast (Delagoa Bay), so is now found to extend right across Africa.

Another very widely distributed species, extending from the Mediterranean region to South Africa, is *C. afra* Lepeletier. The southern form may be regarded as a subspecies, for which the name *pusilla* Gerstaecker, described from Mozambique, is available. I have both sexes of this form from Porto Amelia, June (A. Mackie, J. Ogilvie).

It would appear that the evolution of the parasitic *Coelioxys* has not kept pace with that of the host genus, *Megachile*. This seems especially evident in Australia, where *Coelioxys* is represented by four species, *Megachile* by about 125. But in Australia it is practically certain that the *Megachile*-fauna is for the most part a very ancient one, whereas *Coelioxys* appears to have arrived in comparatively recent times. It is in South America that *Coelioxys* is most abundant and diversified, fairly keeping pace with the large *Megachile*-fauna. Perhaps *Coelioxys* originated in the Neotropical region and has spread thence over the world; but some of the Old World members of the genus represent distinct and peculiar groups, which we suppose to have developed in the regions where we find them. An intensive study of the *Coelioxys* of the world, especially dealing with the biological aspects, would certainly be very interesting and worth while.

Stoeckhert (1932, Deutsch. Ent. Zeit.) gives an excellent account of what is known of these matters in Central Europe. He brings out the fact that although *Coelioxys* belongs to Megachilidae, and is in general a parasite of *Megachile*, it nevertheless has in certain cases shifted to other genera and other families. *C. rufescens* Lepeletier is a regular

parasite of *Anthophora parietina* Fabricius. *C. polycentris* Foerster is believed to be parasitic on *Tetraloma nana* Morawitz. Several species of *Coelioxys* have been raised from nests of *Osmia*. Most of these records appear well established, though confusion may arise from the fact that (as we have observed in Colorado) *Osmia* and other insects nest in the old burrows of *Anthophora*.

NOTE.—*Megachile sticæ* Cockerell, 1935, American Museum Novitates, No. 783, p. 7, footnote, is a misprint for *M. sticææ*.

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RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 5

SEVEN APPARENTLY NEW FORMS OF PHALANGERIDAE FROM THE NEW GUINEA REGION

BY G. H. H. TATE AND RICHARD ARCHBOLD

Continuing the practice already established of publishing preliminary descriptions¹ of new forms of mammals discovered in the Archbold collections, we offer in the following pages diagnoses of two races of *Petaurus*, subgenus *Petaurella*; one race each of *Pseudochirus*, subgenus *Pseudochirops* and subgenus *Pseudochirulus*; and three species of *Phalanger*.

PETAURUS SHAW

The flying phalangers of New Guinea were distinguished by Thomas² as *papuanus*, a race of *P. breviceps* of Australia. Not only was *papuanus* promptly made a full species but in 1916 Matschie³ erected the subgenera *Petaurella* for *papuanus* and *Petaurula* for *breviceps*.

Although Jentink⁴ has suggested that the New Guinea flying phalangers may be susceptible of geographical separation, no action in this respect has hitherto been taken.

The type locality of *papuanus* Thomas is "Huon Gulf" and its characteristics indicate that it was the form prevalent in the lowlands of the eastern part of the islands. The two races proposed by us in the pages following are, in comparison with it, (1) a darkly pigmented form living in the high mountains of eastern and northeastern New Guinea, and (2) a strongly flavid form of the relatively open country in south New Guinea (Western Division).

Petaurus (Petaurella) papuanus tafa, new subspecies

TYPE.—No. 104028, American Museum Natural History; ♂, young adult; Eastern Ridge, Mt. Tafa, Central Division of Papua, 2000 meters; May 19, 1934; collectors, Richard Archbold and A. L. Rand. The type is a skin with skull, the latter with posterior parts broken.

¹ Amer. Mus. Novit., Nos. 801 to 804.

² 1888, 'Cat. Monotr. Marsup.', p. 158.

³ 1916, Mitt. Zool. Mus. Berlin, VIII, No. 2, p. 261.

⁴ 1917, 'Nova Guinea,' V, p. 371.

GENERAL CHARACTERS.—The mountain representative of *papuanus* of eastern New Guinea, characterized by its infuscated ventral pelage and small molar teeth.

DESCRIPTION.—Type with long, soft dorsal fur (12 mm.) colored deep mouse-gray¹ but with a silvery sheen; median stripe fuscous black, slightly expanded on the head as in the lowland form, and reduced at the rump. Ears dark brown. Blackish eye-ring well developed all the way around. Membrane clothed above with blackish hairs; forearm similarly colored; digits and metacarpals black with slight wash of buffy; extreme fringe of membrane buffy from the tip of fifth digit to elbow, then whitish. Hind limb mixed dark gray and buffy whitish, the toes buff. Under parts with bases of hairs buff, followed by a zone of fuscous, and the extreme tips again dirty buff, the last giving the effect of a wash of buffy over fuscous. The hairs along midline from chin to chest have the yellowish of their tips slightly intensified; those of the scrotum are self-colored cartridge buff to their bases. The general ventral color extends onto patagium and limbs. Tail above mouse-gray, the terminal 5 cm. blackish mouse-gray, below drab, terminating in fuscous black.

Skull morphologically as in *p. papuanus*; smaller, due to a certain degree of immaturity. It differs primarily in possessing smaller molar teeth than has its lowland representative, see detailed measurements beyond.

MEASUREMENTS.—Head and body of type, 135 mm.; tail, 155; hind foot (s.u.), 23; skull, palatal length, 15.5; nasals, 12.2×5.2 ; interorbital breadth, 6.5. Teeth: p^4-m^4 , 7.0 (8.0 to 8.2 in lowland representative); m^1 , 4.9 (5.0–5.4); crown dimensions of m^1 , 1.9×1.75 (2.2×1.9); of m^2 , 1.6×1.7 (1.7×1.8).

To this form we refer two males taken by the Whitney South Sea Expedition at Sevia, Huon Peninsula, Mandated Territory, 1700 meters, which equally possess blackish ventral pelage and reduced molars.

***Petaurus (Petaurella) papuanus flavidus*, new subspecies**

TYPE.—No. 104465, American Museum Natural History; ♂, adult; Dogwa, Oriomo River, Western Division of Papua, 30 meters; February 17, 1934; collectors, Richard Archbold and A. L. Rand. The type is a skin with skull, both in good condition.

GENERAL CHARACTERS.—A strongly flavid phase of *papuanus* in which the ventral hairs are self-colored to the bases and without trace of smoky, and the gray of the dorsal parts, particularly of the forearms and adjoining membrane, is heavily washed with yellow-brown. An inhabitant of the relatively open region of southern New Guinea.

DESCRIPTION.—Pelage of type short (8–9 mm. on back), its general color between drab and buffy brown, which extends onto the tail as wood brown or avellaneous, the terminal 5 cm. of which are fuscous. Dorsal stripe, tempered by the prevailing yellowish cast, not darker than bone brown, and the diamond-shaped portion on the crown is paler in the middle. Under parts in type a clear cream buff (chamois in some other specimens), scrotal hairs buckthorn brown, body color (cream buff) carried out for half length of tail, then gradually deepening through seal brown to fuscous.

Skull not distinguishable by us from that of true *papuanus*.

¹ Colors from Ridgway, 1912, 'Color Standards and Nomenclature.'

MEASUREMENTS.—Type, head and body, 149 mm.; tail, 171; hind foot (s.u.), 25; skull, occipitonasal length, 35.8; basal length, 30.4; zygomatic breadth, 25.8; interorbital breadth, 7.7; nasals, 12.3×6.2 ; palatal length, 7.0; teeth, p^4-m^4 , 7.8; m^1-2 , 5.3; crown dimension (length \times breadth) of m^1 , 2.1×2.0 ; of m^2 , 1.8×1.9 .

Mr. Archbold secured a large series of these flying phalangers from the Oriomo River, comprising, besides the type, five adult males, twelve adult females, and five each of juvenal males and females. In young animals the yellowish wash of the upper surface is scarcely developed and the under surface of the body is just off white—about equal to ivory yellow. Many adults have a strong wash of chamois or antimony yellow on the fringe of that part of the membrane attached to the carpus, which is lacking in other races of *papuanus*.

There is some possibility that our Oriomo race may be linked with *longicaudatus* Longman from the Gulf of Carpentaria, Queensland, although the tail in that race was reported as 190 mm. in length (in *flavivus*, 150–175 mm.).

PSEUDOCHIRUS OGILBY

Of the three subgenera of this genus, proposed by Matschie,¹ *Pseudochirops* and *Pseudochirulus* only are known from New Guinea. The former with type *albertisii* is a compact group containing large-sized species with distinctive skull characters; the latter with type *canescens* is more diversified, species at present referred to it varying in size from *caroli* to *pygmaeus*.

Pseudochirus (*Pseudochirops*) *cupreus obscurior*, new subspecies

TYPE.—No. 104114, American Museum Natural History; ♀, adult; west slope of Mt. Tafa, Central Division, Papua; 2400 meters; September 17, 1933; collectors, Richard Archbold and A. L. Rand. The type is a skin and skull, the latter with part of the left maxilla broken.

GENERAL CHARACTERS.—Similar to but smaller and much darker than *cupreus* of the highlands (of which specimens are also at hand for comparison).

DESCRIPTION.—Pelage of type almost as dense as that of *cupreus*, its color darkened by a greater admixture of fuscous to the prevailing coppery brown, the median black stripe extended forward onto the crown and backward to the glandular area at the base of the tail; face dark grayish brown; tail from commencement of glandular area to termination of the portion bearing body-hairs dull chocolate brown, near bone brown, almost lacking any suggestion of coppery; terminal part of tail with adpressed blackish hairs as in *cupreus*. Ventrally as in *cupreus*, with white chest and inguinal patches, the remainder of under parts with the hair-tips grayer and less rufescent. Arms, legs, hands, and feet as in *cupreus* but with the coppery shades dulled.

¹ 1916, Mitt. Zool. Mus. Berlin, VIII, No. 2, p. 261.

Skull of type similar to the skull of *cupreus* and exhibiting the characters of teeth and zygomatica that distinguish *cupreus* from *albertisii*; distinguishable from *cupreus* only by its smaller size, and by the broadly rounded posterior end of the combined nasals in contrast to the more or less W-pattern of *cupreus* proper.

MEASUREMENTS OF TYPE.—Head and body, 395 mm.; tail, 310; hind foot (s.u.), remeasured, 41.5; skull, condylobasal length, 70.3; occipitonasal length, 66.0; basal length, 66.5; zygomatic breadth, 43.9; interorbital breadth, 7.3; nasals, 20.0×11.7 ; crowns, p^4-m^4 , 22.0; crowns m^1-3 , 14.5; crown dimensions of m^1 , 4.9 (length at middle of crown, not at outer edge), by 4.2 (width); of m^4 , 4.0 by 3.8.

Besides the type, we refer two other specimens taken by Archbold and Rand to *cupreus obscurior*, one an adult male also from Mt. Tafa, and the other a juvenal male from Mafulu, 1700 meters.

Thus it appears that the race *obscurior* occupies the southern slopes of the main range at least between 1700 and 2400 meters. Our animals which we refer to true *cupreus* were taken at Mt. Tafa, 2500 meters, and at Murray Pass, Mt. Albert Edward, 2860 meters. *Obscurior* requires comparison with *beauforti* of the Noord River region, southern Dutch New Guinea.

Pseudochirus (Pseudochirulus) forbesi longipilis, new subspecies

TYPE.—No. 104037, American Museum Natural History; ♂, adult; Mave, Tafa Range, Central Division of Papua; 2225 meters; September 6, 1933; collectors, Richard Archbold and A. L. Rand. The type is a skin and skull in good condition.

GENERAL CHARACTERS.—The mountain representatives of *Pseudochirus forbesi* but with long, very dense pelage.

DESCRIPTION.—Dorsal pelage of type composed of long soft fur from 13 to 15 mm. in length (10 mm. in true *forbesi*), the scattered guard-hairs reaching 20 mm. Color only very slightly darker than in characteristic *forbesi*, namely, tawny orange on cheeks and head, merging into the dull brownish gray of the body; an indistinct darker band near bone brown running from withers to sacrum; the tail dull wood brown, becoming almost black distally. Hands and forearms dull tawny; feet cartridge buff to cream buff. Ventrally cream buff on throat and chest, becoming cartridge buff on belly, and deepening again to cream buff in inguinal region. All ventral hairs gray-based; their length 10–15 mm. (5–8 mm. in true *forbesi*). Ventrally body color carried for some 3 cm. down under surface of tail, gradually becoming wood brown. Bare under surface of tail about 120 mm. Pattern of head, face, and ears just as in *forbesi*.

Skull of type virtually identical to that of true *forbesi*, displaying similar fenestration of both maxillary and palatine portions of palate, similar degree and location of the inflation of the auditory region.

MEASUREMENTS.—Head and body of type, 256 mm.; tail, 259; hind foot, "35.6"; basal length of skull, 46.2; zygomatic breadth, 29.2; interorbital breadth, 5.8; mastoid breadth, 25.2; nasals, 16.3×7.6 ; palatal length, 25.2; crowns p^4-m^4 , 14.6; crowns m^1-3 , 10.0; crown width of m^1 , 2.5.

Evidence favoring the recognition of this mountain race of *forbesi*

rests upon the type and a second male (topotype, but from 2400 meters) of equal age and possessing similar characters of pelage. Lack of anatomical characters in the skull to accompany the differences in the fur only emphasizes the view that *longipilis* is purely an offshoot of *forbesi* adapted to conditions in the highlands. The two races may intergrade, but the fact that a specimen of typical *forbesi* taken from the eastern slope of Mt. Tafa only a few hundred meters lower than *longipilis* is in no respect intermediate indicates that the latter is likely to be an upland race distinct from the lowland race *forbesi*.

PHALANGER STORR

This genus, with type *orientalis* from Amboina, off the coast of Ceram, comprises four strongly marked species groups, namely: *orientalis*, *celebensis*, *ursinus*, *maculatus*. The first only has speciated freely, giving rise, in addition to the several "subspecies" of *orientalis*, to such well-marked full species as *leucippus* and *sericeus*. Stein¹ has tentatively suggested groupings of the members of the *orientalis* group, and Schwarz² has recently published certain conclusions based on pelage, with some of which (particularly making *celebensis* a subspecies of *orientalis*, p. 88) we cannot concur. For the remaining groups, names are already available, should it be considered desirable to set them off as subgenera at some future time.

Phalanger brevinasus, new species

TYPE.—No. 104100, American Museum Natural History; ♂, adult; Mafulu, Central Division of Papua; 1250 meters; October 24, 1933; collectors, Richard Archbold and A. L. Rand. The type is a skin and skull in good condition.

GENERAL CHARACTERS.—A large phalanger of general *orientalis* type, and of size very slightly less than true *orientalis*, colored very pale, uniform mouse-gray with a brownish cast, the dorsal line moderately developed. Skull with premaxillae and i¹⁻¹ thrown well forward but at the same time nasals quite short.

DESCRIPTION.—Pelage of type soft, short (about 15 mm. on the back) and dense, the color light mouse-gray with a slight brownish cast, becoming light buffy gray over the glandular area above the base of the tail; dorsal stripe light fuscous, of less intensity on neck and terminating at sacral region; face, cheeks, sides of neck, lower part of sides of body, insides of limbs, and inguinal area a very pale gray, approaching drab-gray of Ridgway; hairs of tail above buffy mouse-gray, below light drab; dorsal hair extended for 180 mm. along tail; ears light fuscous, their margins naked; vibrissae black; dorsal color of hands and feet light drab. Naked part of tail coarsely granulated proximally beneath, flesh-colored with some darker mottlings. Under parts, with exception of chin which is between drab and hair brown, between white and cartridge buff, the lower throat and upper chest suffused with cream buff.

¹ 1933, *Zeitschr. Säugetier-k.*, VIII, Heft 2, pp. 90-91.

² 1934, *Proc. Zool. Soc. London*, pp. 88-91.

Skull of type with the outline of true *orientalis* but supraorbital ridges less separated and interorbital trough narrow; nasals short, their tips but little (1.5 mm.) exceeding the nasal notch, their narrowest point just anterior to maxilla-premaxilla suture, their broadened proximal parts reaching to 2 mm. from lacrimal, their posterior V-suture wide and entering only 6 mm. between the anterior swellings of the frontals; premaxillae projecting from 6 to 7 mm. beyond nasals and first incisors markedly proödont; palate as in *orientalis*; mastoid width much greater than in *orientalis*, 85 per cent of zygomatic width, as compared with 75 per cent in true *orientalis*; mastoid-squamosal support for stylohyoid apparatus more extended laterally but less inflated anteroposteriorly than in *orientalis*; depression between paroccipital process and basioccipital shallower than in *orientalis*; alisphenoid "bulla," by covering more of tympanic, making a much broader contact with mastoid.

ТЕETH.—Canines lacking the incipient anterior cuspule sometimes to be noted in *orientalis*; p⁴ smaller and simpler than p⁴ of *orientalis*; molar series exhibiting more size-gradient from m¹ to m⁴ than in *orientalis*.

DIMENSIONS.—Skin of type, head and body, 440 mm.; tail, 395; hind foot (s.u.), 57¹; skull, basal length, 79; zygomatic breadth, 56.2; mastoid breadth, 47.5; nasals, 29 × 14.3; palatal length, 46; interorbital width, 9.7; crowns p⁴ - m⁴, 24.3; crowns m¹⁻³, 15.8; crown dimensions, p⁴, 5.1 × 4.1; m¹, 5.3 × 4.4; m², 5.0 × 4.8; m³, 4.5 × 4.4; m⁴, 4.4 × 4.1; width posterior lamina of p⁴, 3.3.

Besides the type we have before us a second male skin and skull, slightly younger but otherwise the same, and a skull without skin, both topotypes.

In addition to the mouse-gray *P. brevinasus* we have to describe two distinct forms of *Phalanger* with a rufous pelage which are at once separable from one another by their teeth, m¹⁻³ in the one, from Central Division of Papua, measuring 15.8 mm., and in the other, from Western Division (Oriomo River), only 13.2 mm.

Thomas² writes of "the well-known red juvenile phase" [of *orientalis*], while synonymizing *Pseudochirus vulpecula* Foerster with *Phalanger orientalis* (Pallas); and the name *rufa* was applied by Geoffroy³ to a form of *Phalanger* which Jentink⁴ (and everybody after him) includes in the synonymy of *orientalis*. Foerster's juvenal specimen of *vulpecula* was described as having the tail with the "last 115 mm. . . naked, black," and although it came from the Huon region it is not improbably related to our reddish forms. *Rufa* Geoffroy is best regarded as unidentifiable. With due respect for the opinion of Thomas (cited), we feel that in the present rufous-hued phalangers we are concerned with forms that are not closely linked genetically with *orientalis*. Our series in each instance is too uniform and there is lacking any local normally colored repre-

¹ Field measurement.

² 1922, *Ann. Mag. Nat. Hist.*, (9) IX, p. 673.

³ 1808, Geoffroy St.-Hilaire, E., 'Cat. du Muséum,' p. 149.

⁴ 1885, *Notes Leyden Museum*, VII, p. 93.

sentative of *orientalis* to which the rufous animals may be recessive (or dominant?) when crossed. It is true that the large-toothed rufous phalangers have skulls that to a considerable degree match the skulls of *brevinasus* (whose female is not known), but we have yet to be convinced that the former is the female of *brevinasus*, for the young males collected at several lowland stations are even more strongly rufescent than the single adult female is. Accordingly, we describe the large-toothed form provisionally and the small-toothed series (from Oriomo River) as almost certainly new.

Phalanger matsika, new species

TYPE.—No. 104103, American Museum Natural History; ♀, adult (though teeth scarcely worn); Matsika, Angabunga River, Central Division of Papua; 950 meters; November 22, 1933; collectors, Richard Archbold and A. L. Rand. The type is a skin in good condition and a skull with left m^4 lost.

GENERAL CHARACTERS.—A reddish-gray phalanger with naked portion of tail black, dark brown chin, sides and inguinal area, and creamy white from throat to pouch; the skull very close in structure to that of *brevinasus*.

DESCRIPTION.—Dorsal pelage of type near natal brown, the individual hairs often with a metallic glint, becoming duller, near bone brown on head, sides, rump and base of tail; dorsal line fuscous, well developed from crown to lumbar region; length of back pelage, 20–25 mm.; fore and hind limbs near natal brown; a straw-colored spot behind and below ear; under parts from back of chin to pouch near cartridge buff, the width of the pale area from 4 to 6 cm.; the whitish area surrounded by color changing between verona brown, benzo brown, and sepia (varying with degree of wear of the verona brown hair-tips), which colors cover chin, sides of neck, insides of limbs, lower sides of body and base of tail; ears with tips bare, fuscous; bare part of tail fuscous, but a suggestion of flesh-color on prehensile inferior surface.

Skull of type with frontals swollen so as largely to eliminate the interorbital trough anteriorly; interorbital ridges little separated; nasals with wide posterior V-suture and exceeding nasal notch only slightly (2 mm.); mastoid width great; mastoid and audital set-up very similar to that in *brevinasus*; posterior palatal openings small, only 30 per cent of palatal length.

TEETH.— I^2 not reduced from its normal large size; p^4 moderately large with shear faces, its tip doubled; molars large as in *brevinasus* and in the *sericeus* group; m^4 level with back of palate.

MEASUREMENTS.—Head and body of type (female), 402 mm.; tail, 373; hind foot (field measurement, s.u.), 58; skull, basal length, 71.2; zygomatic breadth, 44.5; interorbital breadth, 10.1; nasals, 26.5×12.7 ; palatal length, 41.0; crowns, p^4-m^4 , 24.3 ; m^1-m^3 , 15.8 ; crown dimensions, p^4 , 4.9×4.0 ; m^1 , 5.1×4.4 ; m^2 , 4.8×4.5 ; m^3 , 4.8×4.4 ; m^4 , 4.4×3.9 .

We refer to this form six additional specimens: two juvenals, male and female, topotypes; juvenal male from Bellavista, 1450 meters; juvenal male from Mafulu, 1250 meters; juvenal female from Deva Deva, 770 meters; and juvenal male from Ononge, 1860 meters. The last mentioned is not only strongly rufescent (near tawny or russet) but

even carries in its pelage occasional black guard-hairs such as Foerster described in *vulpecula*.

The dimensions of the teeth (the only anatomical parts safely comparable between adults and young) are remarkably constant and furnish a ready means of distinguishing *matsika* from the species next to be described.

Phalanger microdon, new species

TYPE.—No. 104401, American Museum Natural History; ♀, adult; Dogwa, Oriomo River, Western Division of Papua; 30 meters; February 27, 1934; collectors, Richard Archbold and A. L. Rand. The type is a skin and a skull with the occipital region somewhat broken.

GENERAL CHARACTERS.—A strongly reddish species possibly related to "*Pseudochirus vulpecula*" (see our remarks above); dorsal line moderately distinct; ventral color from throat to pouch broadly white but otherwise grayish brown; skull with extremely small teeth only equaled by the small-sized *celebensis* of Celebes and *breviceps* of the remoter Solomon Islands.

DESCRIPTION.—Pelage of back of type reaching 15 mm., its general color between orange-cinnamon and mikado brown but with an added kinkiness that provides a distinct luster; dorsal line fuscous, reaching, with a slight break at the neck, from crown to sacrum; lower rump and base of tail somewhat paler and duller, near sayal brown or ochraceous tawny, which color appears also on face, limbs, hands, and feet; a light buffy spot behind each ear; vibrissae black basally, their tips whitish; naked part of tail entirely black; under parts, from just behind the ochraceous tawny of the chin to the pouch dull white, that color extending broadly across the chest (10 cm.) and onto fore limbs, but sternal area well tinged with cream buff; the narrow interval between the rufous dorsal and whitish ventral areas, together with the whole inguinal region and inside of hind limbs, army brown; under parts of tail and anal area cinnamon.

Skull of medium size to small, essentially similar in structure to those of *matsika* and *brevinasus* and, like them, provided with very widely expanded mastoids; palate extending far behind the last molars, due to the small size of the teeth; posterior palatal openings slightly more than one-third of length of palate.

Teeth remarkably small: i^3 crown only 2.7 mm.; a slight space between i^3 and c ; p^4 small and relatively simple; a well-marked size-gradient in the molars.

MEASUREMENTS.—Skin of type, head and body, 396 mm.; tail, 324; hind foot (s.u., field measurement), 54.8; skull, basal length, 72.5; zygomatic breadth, 47.9; interorbital breadth, 12.6; mastoid breadth, 42; nasals, 27.4×12.7 ; palatal length, 42.0; crowns, p^4 - m^4 , 21.0; m^1 - m^3 , 13.2; crown dimensions, p^4 , 4.0×3.6 ; m^1 , 4.5×3.6 ; m^2 , 4.2×3.8 ; m^3 , 3.9×3.7 ; m^4 , 3.9×3.5 .

Besides the type there are two subadult females and one juvenal male topotypes. The larger of the females is somewhat darker than the type and both have the white of the under parts narrowed on the chest to 3 cm. In the juvenal male the rufous takes on a sandy tone, resulting in a dorsal color near sayal brown or ochraceous tawny; the head and neck are slightly darker; the dorsal stripe appears obsolescent.

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AN ALMOST TOTALLY AMBICOLORATE HALIBUT, *HIPPOGLOSSUS HIPPOGLOSSUS*, WITH PARTIALLY ROTATED EYE AND HOOKED DORSAL FIN—THE ONLY RECORDED SPECIMEN

BY E. W. GUDGER AND FRANK E. FIRTH

INTRODUCTION

For the past three years, Gudger has been studying abnormalities—particularly ambicoloration in flatfishes. For this study, Firth (of the U. S. Bureau of Fisheries), from the vantage ground of the Boston Fish Pier, has from time to time enriched the collection of teratological fishes in the American Museum with such specimens.

On the morning of February 14, 1935, Gudger read in the *New York Times* that on the previous day "An all-black halibut was displayed at the Boston Fish Pier . . . the first ever seen there." He hurried to his office to get in touch with Firth, and there found a letter from him giving the essential facts. Further correspondence and considerable personal investigation have enabled us to trace the history of this unique specimen.

HISTORY OF THE SPECIMEN

This teratological halibut was taken on February 4 or 5 by the trawler, *Oretha F. Spinney* of Gloucester, Massachusetts, on the first halibut trip in 1935. It was caught on a line trawl in 200 fathoms of water on St. Peter's Bank east of the northern part of Nova Scotia. The fish was landed on the Boston Fish Pier on February 13, one fish in a catch of 35,000 pounds of halibut made by this vessel. It measured 5 feet 5 inches from tip of snout to fork of the caudal fin, and weighed, without gills and viscera, 55 pounds.

Photographs of the fish were made while it was fresh. Two of these negatives were purchased by the Museum, and two others were presented to the Museum by Firth. These photographs and Firth's notes of the specimen comprise the data from which this article is written. It should be noted here that this is the only black-bellied *Hippoglossus* on record not only in America but also for the world. Hence these photographic negatives are literally unique—the only ones

ever made, not only of an abnormal halibut but of any ambicolorate flatfish with head deformities.

A wholesale fish dealer purchased the halibut on speculation (mainly because it was a curiosity) and displayed it in the window of a retailer in Boston, and later brought it back to his own store. But he found slow sale for it, since there is in Boston a prejudice against such parti-colored flatfish, although in Great Britain such are highly prized. There it is believed that black-bellied flatfish have the muscles of the lower side better developed than those of the normal white-bellied fish and hence that the flesh is firmer and better tasting.

In the meantime the picture of the fish had appeared in the daily papers. The resulting publicity and general interest in this freak gave the owner an exaggerated idea of its value. He wished to sell the fish as a whole, but both Firth and Gudger realized the difficulty of getting so large a fish to the Museum and of preserving it when there. A liberal price was offered for the head, but the dealer refused this and in Firth's absence cut off the head and threw it in the harbor. But in the meantime Firth had secured five separate photographs of the lower side of the fish.

THE NORMAL FISH

In order that the marked abnormalities of our fish may be more readily perceived and understood, we insert here a figure showing the right or upper side of a normal halibut. In this figure, attention is called to three particular structures in the make-up of this, the largest member of the flatfish group: (1) Along the dorsal and ventral edges of the dextral or upper side are certain small whitish blotches. Whatever the cause, these are not abnormalities, since they are generally present and are more readily seen on the larger halibuts. (2) Note the large jaws filled with large strong recurved teeth. These indicate that our fish is an active predator. (3) Particular attention is called to the very high position of the upper, the rotated or left eye. While clear of the dorsal crest, it is very close to this. Furthermore, the anterior termination of the dorsal fin reaches to and often beyond the middle point of this migrated eye. The whole lower surface of this normal fish is of course dead white in color. See Fig. 1.

It should be stated here that at Boston and Gloucester two grades of halibut are distinguished: First, those fish having pure white undersides, which bring the highest price; and second, those having the

under-side of a more or less uniform grayish cast. These bring a lower price. These are called "gray halibut" and are generally the larger fishes. However, the grays are halibut and are recognized by the fishermen as different from the others only in this matter of the faint lower-side coloration. This grayish color has, moreover, nothing to do with ambicoloration.

THE ABNORMAL FISH

Our specimen is the most abnormal fish which Firth has ever seen or handled, and perhaps the most unusual and unique that Gudger has found in three years of study of specimens and literature. It is the largest ambicolorate flatfish on record and the only *Hippoglossus hippoglossus* known to show the marked anomalies now to be considered. However, halibut are sometimes taken having on the under-side spots or patches of the same dark color as that distinguishing the upper-side. These are known to the fishermen as "circus halibut." Our fish was thus denominated by the fishermen at Boston, but all declared that they had never seen one with such a black lower-side nor with such head anomalies.

COLOR ANOMALIES.—As Fig. 2 shows, this halibut is nearly dark all over the whole lower surface. On the fins, the basal half of the pectoral is black, and the dorsal and anal are dark save for the white edges and some white in the membrane between the rays. In our best photograph (Fig. 2), the fish is not swung up high enough for the caudal to clear the ground, but other photographs show all the caudal save the hinder third to be very black.

This halibut had been eviscerated and the gills removed when captured, long before the photographs were taken. The hanging of the fish from the head-region has pulled the gill-region of the head away from the anterior end of the ventral part of the body. This area (to the left of the base of the pectoral fin) shows up white in Fig. 2, but this has nothing to do with ambicoloration, since this region (which is normally covered by the gill and throat parts) is normally white. The same remarks apply to the normally gray interior of the mouth as seen.

Interest is now focussed on the head, where the hinder half of the gill-covers, all the lower jaw region and the maxilla of the upper jaw are dark, as is the upper part of the head beneath and to the rear of the rotating eye. For these things see Fig. 2.

Except for the small white regions indicated, the whole under-surface is not only dark but darker than the upper-surface. The posterior third of the under-surface of the body proper and the base of the caudal are darkest, as the figure shows, but even forward of this region the fish is very dark—it is literally a “black belly,” as these totally or nearly completely ambicolorate flatfishes are widely known. Let the reader just here compare the appearance of the under-surface of our anomalous specimen with the completely white under-surface of the normal smaller fish held in the fisherman’s right hand, as shown in Fig. 2.

POSITION OF EYE.—The position of the partly rotated eye is of especial significance. As may be seen in Fig. 1, in the normal halibut

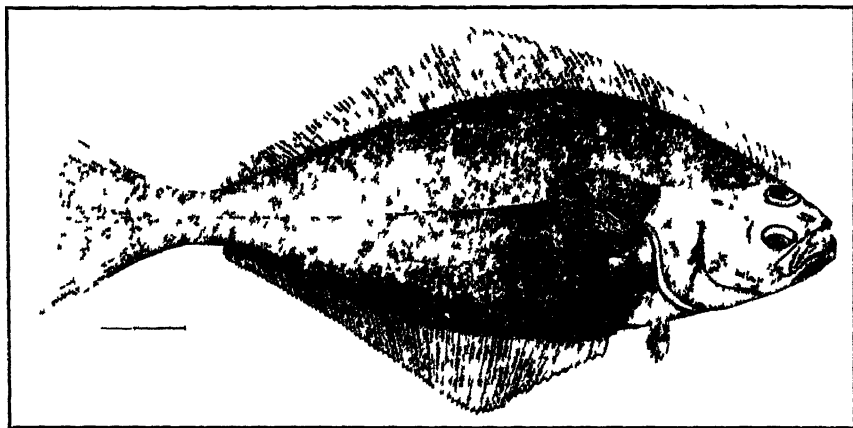


Fig. 1. Upper-surface of a normal halibut, *Hippoglossus hippoglossus*. Note that the rotated eye is placed high on the side of the head, near the dorsal crest but free of it, and that the dorsal fin ends about in line with the middle of the rotated eye. The spots on the dorsal and ventral edges of the body are not abnormalities, as the text explains.

After G. Brownie Goode, 1894

the left or rotated eye has migrated from the left side across the dorsal crest. It is clear of this ridge but it is placed high on the right side of the head and very near to the dorsal crest, without, however, interfering with the normal development of the anterior part of the dorsal fin.

As Fig. 2 shows, in the abnormal fish, the left eye has paused in its migration and remains almost on the dorsal ridge. Firth states that



Fig. 2. Ventral surfaces of two halibuts (*Hippoglossus hippoglossus*). The smaller fish has the normal white under-surface. The larger or abnormal fish is nearly completely dark below, has an incompletely rotated eye and a hooked dorsal fin—both of which are absent in the normal fish.

From a photograph

from two thirds to three fourths of the eye had passed over the dorsal crest toward its normal position on the right side, while the remaining fraction rested on the crest. How abnormal this condition is can be realized by comparing the under-side head of the smaller normal fish with that of the larger ambicolorate one. In the normal halibut the left eye has moved clear over the dorsal ridge and is hence invisible, while in our specimen the left eye is still visible from the blind side.

Attention should be called just here to the fact that the rotating eye does not have far to move across the crest to reach its normal position. To see just how small this distance is, note the position of the upper eye in Fig. 1. A very slight retardation in the migration of the left eye will produce the eye condition shown in Fig. 2.

HOOKE DORSAL FIN.—The failure of the left eye to move completely over the dorsal crest and its permanent position on the edge of the crest have interfered with the normal forward development and completion of growth of the anterior part of the dorsal fin. Let the reader here note the normal position and origin of the front part of the dorsal as portrayed in the large fish shown in Fig. 1 and in the smaller one in Fig. 2. This retardation of the growth of the dorsal has resulted in the formation of the hook seen in Fig. 2. The formation of such a hooked dorsal is almost invariably associated with the incomplete migration of the eye.

BEHAVIOR.—Nothing is known of the habits of black-bellied halibuts. Extreme ambicoloration is known to occur in the smaller (not younger) halibuts and in larger (not older) flounders of the family *Pleuronectidae*. Since these large fishes have strong jaws and large teeth and are both voracious and predatory, it has been suggested that the markedly ambicolorate forms with their high-placed (cyclopean?) eye swim with the body in normal fish position (dorsal and anal fins in a vertical plane) as the young do until metamorphosis. So far as we know there is no evidence, observational or experimental, for this conclusion. Presumably such fish swim on the side (here left) in normal flatfish fashion.

Other than the statements made above, no effort will be made now to explain the anomalies found in this halibut. The endeavor here is to set out the facts. Gudger, who has been studying these phenomena for some years, has in progress a series of extensive papers reviewing all the literature of these various flatfish anomalies and bringing together all the known data in an endeavor to find explanations.

SUMMARY.—Finally, special attention should be called to the two head abnormalities in conjunction with the relatively large amount of white on the under-surface of our fish. This situation is very unusual.

Gudger has found in one specimen described by him and in an extensive search through the literature that even with the whole under-surface of the body and *less* than half the head dark in color no head abnormalities are to be expected. Furthermore, in cases where most of the head and body are dark in color but where there are considerable white areas scattered over the under-surface, no head abnormalities may be expected.

But in our halibut, the forepart of the head, the spread-out part of the pectoral, the hinder third of the caudal are all white and in addition the dorsal and anal show white fringes. Yet there is found an incompletely rotated eye and a hooked dorsal fin—structures usually associated with extreme ambicoloration. This halibut certainly is one of the most anomalous flatfishes on record.

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NEW AMERICAN DIPTERA

By C. H. CURRAN

Descriptions of twenty-one new species of American flies are given in the following pages, together with keys for the separation of the species belonging to some genera. With the exception of *Villa handfordi*, the types are deposited in The American Museum of Natural History.

BOMBYLIIDAE

Among a considerable number of specimens of *Villa* collected and reared by Mr. R. H. Handford at Aweme, Manitoba, there is a fair series of an undescribed form showing a distinct relationship to *alternata* Say and *molitor* Loew. In most of the specimens there is a tuft of black hairs on each side of the third abdominal segment as in *alternata*, but the mesonotum and scutellum are clothed with golden brownish or ferruginous tomentum and the tomentum of the abdomen is very largely of this color while the pale pile is more yellowish than in typical *alternata*. The pupae of the two species show well-marked differences, the upper caudal hooks having no median spur in the new form but having a strong sub-basal spur in *alternata*.

Villa handfordi, new species

Wings hyaline, the subcostal cell and narrow base of the wing reddish brown; abdomen fasciate with black, ferruginous and whitish tomentum. Length, 12 to 13.5 mm.

FEMALE.—Head wholly black in ground color; front moderately wide above (three times as wide as the ocellar triangle), widening anteriorly; hair black, the scales golden reddish or yellowish. Occiput clothed with rather golden scales. Face with black hair, dense in the middle especially immediately above the oral margin, rarely mostly pale tawny, the scales golden to pale golden yellow. Proboscis projecting but little beyond the anterior oral margin. Antennae black, black-haired, the basal segment with white hair below on the inner side; second segment wider than long, the third basally a little larger than the second, sharply tapering to the stylelike portion.

Thorax black in ground color, thickly yellowish pilose, the disc of the mesonotum

with thin pale yellowish pile and clothed with rusty reddish or golden brown scalelike tomentum that conceals the ground color, sometimes with a pair of obscure, broadly separated, incomplete black vittae. Scutellum with rusty brownish red scales and thin pale pile, a few black scales intermixed basally, rarely forming a narrow short, black basal band.

Legs black in ground color. Coxae with yellowish scales and pale yellow pile. Femora with rusty reddish scales, black apically at least above; front tibiae black with rusty scaling posteriorly; middle tibiae with black scales only below, the posterior tibiae subciliate, the scales mostly black in front, mostly tawny behind; tarsi black, the first segment with some tawny scales. Front tibiae with moderately short black spicules; anterior claws short.

Wings hyaline, the subcostal cell and the base of the wing reddish brown; epaulet clothed with mostly black scales or almost wholly with reddish ones, the tawny scales sometimes extending to beyond the middle of the broadened costal region. Squamae brown with orange fringe. Halteres reddish yellow.

Abdominal pile yellowish or cinereous yellow, long on the sides, black on the sides of the third, fifth, and sixth segments, on the third segment sometimes with only a few black hairs. First segment with tawny tomentum, usually with black scales intermixed on the disc and with some white tomentum on the apex toward each side. Second segment with the basal two-fifths white tomentose, the apex tawny tomentose, a median, incomplete fascia partly or wholly black-scaled. Third segment fasciate like the second but the basal white band is narrow, the black fascia wide and usually entire, rarely greatly reduced and inconspicuous. Fourth segment with white scales and a narrow, incomplete fascia of black or tawny scales. Fifth and sixth segments with the base clothed with black scales, the broad apices with white scales; seventh segment with black scales on the disc, white on the sides, and tawny on the apex. The scales toward the sides of the abdomen are longer and less tomentum-like than those on the disc and may encroach, to some extent, upon the lateral hair-tufts. Scales of the venter mostly white but there may be black basal fasciae on the fifth and sixth sternites and the seventh sternite may be mostly black. The sides of the second abdominal segment may be reddish in ground color.

MALE.—Front little wider than the ocellar tubercle on the upper sixth; antennae sometimes without pale hair; pile on the disc of the mesonotum more abundant, the tomentum less scalelike; upper surface of the scutellum mostly black tomentose, the tawny scales limited to the broad free border, the sides sometimes with some pale yellowish scales. Legs usually mostly clothed with black scales, rarely as in the female. Abdomen never as in the female, the disc sometimes mostly black tomentose, with the apices of the fourth to sixth segments white, or mostly white tomentose with incomplete and irregular fasciae of tawny and black, or with the black and tawny scales intermixed with the white on the basal half of the segments, but the third segment always darker than the preceding or following segment. Fifth segment always with white or tawny scales at the apex.

TYPES.—Holotype, female, Aweme, Manitoba, August 24, 1932, from *Porosagrotis vetusta* Walker. Allotype, male, Aweme, August 25, 1931. Paratypes, five specimens of each sex, Aweme, July 23, 1931 (No. 72), August 22, 1931 (No. 403); July 11, 14, 19, and August 13, 14, 1934, all collected or reared by Mr. R. H. Handford. Types in the Canadian National collection, paratypes in the American Museum.

SYRPHIDAE

Microdon laetoides, new species

Very similar to *laetus* Loew, from Cuba, but there are very few black hairs on the front and the tarsi are whitish haired on at least the basal half. Bright metallic green species with bluish and violaceous reflections. Length, 10 mm.

FEMALE.—Head green, yellowish white pilose, a few black hairs near the ocelli; front slightly narrower than the face, much longer than wide, the sides rather broadly white pollinose on the lower half. Ocellar triangle with equal sides, situated well before the posterior angles of the eyes. Face moderately convex, the sides with a moderately wide band of whitish pollen. First antennal segment almost as long as the third, three times as long as the second, the hair black.

Thorax shining green, with rather strong violaceous reflections, the pile very pale yellowish. Scutellum wider than long, the apex strongly emarginate and with a pair of strong spines on each corner, the spines separated by a distance equal to about one-third of the basal width of the scutellum.

Coxae and femora green, their tips and the tibiae reddish yellow, the tarsi black. Pile whitish, brown apically on the upper surfaces of the tarsi, appressed and partly yellowish on the bases of the tarsi.

Wings cinereous hyaline, the cross-veins bordered with brown; apices of fourth and fifth veins recurrent, the posterior apical corners of the discal and first posterior cells very broadly rounded. Squamae white, the halteres yellow.

Abdomen metallic green, with violaceous reflections laterally and apically, the hair wholly yellow, almost white on the sides. The second abdominal segment is short, widest apically, the others poorly differentiated. Owing to the arrangement of the short, appressed hair there is a distinct tessellate pattern in some views.

HOLOTYPE.—Female, Globe, Arizona, October 1, 1933 (F. H. Parker).

In related species the hair on the dorsum of the abdomen is mostly black. The specimen was received from Mr. D. K. Duncan.

COPESTYLUM MACQUART

I present a key to the species of this genus known to me.

TABLE OF SPECIES

- 1.—Pile of the fourth abdominal segment composed of erect and suberect hairs of ordinary form.....2.
Pile of fourth abdominal segment subappressed and composed of distinctly flattened hairs of almost equal length.....*caudatum* Curran.
- 2.—Wings brown on the apical half in front of the third vein...*limbipennis* Williston.
Apex of the wing very broadly pale except for weak clouds on the cross-veins...3.
- 3.—Pile of the fourth abdominal segment wholly whitish.....4.
Pile of the fourth segment partly black.....7.
- 4.—Wings with a large median brown cloud in front.....*salti* Dobrosky.
Wings with only minute dark spots.....5.
- 5.—Tarsi wholly black or very obscurely pale at the immediate base of the middle pair.....*fax* Townsend
Basal two tarsal segments reddish or yellowish.....6.

- 6.—Venter black except laterally; tibiae not pale basally *simile* Giglio-Tos.
 Second and third sternites yellowish or mostly so. *marginatum* Say.
 7.—Sternopleura wholly black; dark-colored species. 8.
 Sternopleura with large yellowish spot above; abdomen mostly pale. *schwarzi*, n. sp.
 8.—Wings with large blackish cloud in the middle. *bequaerti* Curran.
 Wings without such cloud. *lentum* Williston.

Copestylum fax Townsend

Volucella fax TOWNSEND, 1895, Trans. Amer. Ent. Soc., XXII, p. 42.

I am not certain of the status of this form and it may be nothing more than a dark variety of *marginatum* Say. The legs are less extensively pale and only the middle tarsi show any reddish on the basal fifth of the first segment. In some specimens the venter is wholly black, but the color varies and some have the venter as extensively pale as in *marginatum* although this is restricted to the females. The pile of the thorax and scutellum is much more predominantly black in the males which also have the face mostly black-haired. It is possible that the females with the venter pale do not belong with the males despite the black tarsi. There is a great deal of variation in the color of the abdomen of *marginatum* but it is constant in *fax*, the sides of the second segment being wholly black in the latter. More material is needed to clear up this problem.

Copestylum schwarzi, new species

An unusually pale-colored species in which the cross-veins on the apical half of the wings are distinctly bordered with brown. Length, 9.5 mm.

FEMALE.—Head pale yellowish; occiput black, thickly whitish pollinose, the vertex and a spot above the neck reddish yellow; front with a grayish spot toward either side above the antennae and a smaller one on each side above the middle; pile yellow, white on the occiput, a few black hairs on the vertex. Front strongly widening from the vertex anteriorly, unusually narrow above. Cheeks and face separated by a narrow brown stripe; face with a median brown vitta on the lowest three-fourths. Antennae reddish brown, the second segment about three-fourths as long as the third; arista blackish, very densely haired. Eyes with short yellow and white hair.

Disc of the mesonotum shining black, a pair of large, contiguous spots in front of the scutellum and the broad lateral margins yellow; in the middle anteriorly with a pair of broad, subcontiguous gray pollinose vittae. Scutellum reddish yellow. Pleura brownish, a very large spot on the mesopleura, a large spot on the upper part of the sternopleura and a spot behind it, yellow, the pteropleura and some of the incisures more or less luteous. Pile pale yellow, black on the apical half of the disc of the scutellum.

Legs black; tips of the femora, basal third or more of the tibiae, their tips and the basal two tarsal segments reddish yellow; pile mostly black, pale ventrally on the femora and toward the lower posterior surface.

Wings hyaline, the veins bordered with yellowish brown, the cross-veins with darker clouds, the posterior veins scarcely clouded. Squamae white with pale yellow fringe. Halteres yellow.

Abdomen rusty reddish yellow, the lateral margins wholly black; apical third of the second segment and the apical three-fourths of the third with strong brown tinge. Pile golden yellow, black on the dark bands. Venter reddish yellow, with pale pile basally and black hair apically except on the sides of the sternites.

HOLOTYPE.—Female, Curaçao, August 26, 1934 (H. F. Schwarz).

CALLICERA PANZER

This genus contains only three species described from America and a small number from the Old World. The American species are separable as follows.

TABLE OF SPECIES

- 1.—Face golden or pale yellowish pilose.....2.
Face black pilose (Colorado).....*montensis* Snow.
- 2.—Antennal style very short and stubby, not longer than the thickness of the third segment; abdomen uniform in color (Eastern States)...*johnsoni* Hunter.
Antennae with a long white style.....3.
- 3.—Pile of the face, sides of the thorax and on the abdomen golden (Mexico).
poultoni Verrall.
Pile yellowish white, the mesonotum with black hairs intermixed (Arizona).
duncani, n. sp.

Callicera duncani, new species

Related to *poultoni* Verrall but readily distinguished by the color of the pile. Length, 10 to 12 mm.

MALE.—Frontal triangle shining black, thinly brownish pollinose except anteriorly, without pile; vertical triangle slightly shining black, black pilose, the vertex with black pile extending but little onto the posterior orbits. Occiput shining black, pale yellowish pollinose along the orbits except above, the pile short, thick, yellowish white. Face shining black, rather thickly yellowish white pollinose except on a median vitta. Antennae black; third segment more or less reddish below on the basal half, broad on the basal half, thence tapering to the tip; arista elongate, white, merging to orange then brown at the base. Eyes with black pile, the pile white below and mixed black and white on the lower half, the white predominating in front and behind, leaving a black or brown stripe extending to the facial orbit below.

Thorax dull brownish black, the pleura somewhat metallic, the mesonotum with four weak brownish gray vittae. Pile of the mesonotum mixed black and pale yellowish, the black predominating in front, the pale pile behind, the sides behind the suture, anterior border except in the middle, the border of the scutellum and the pleura with dense yellowish white hair; scutellum somewhat shining, with thin pale pile on the disc; pectus with black hair.

Legs black; tips of the femora and the tibiae reddish, the tibiae with or without broad, diffuse brown bands; middle and posterior tarsi with the first segment mostly

reddish. Pile whitish yellow, black on the coxae, trochanters, lower surface of the femora and on the tarsi.

Wings cinereous hyaline, the costal border broadly reddish brown except in the costal cell. Squamae rather grayish, the dorsal hairs and fringe brown or tawny. Halteres yellow with the knob tinged with brown.

Abdomen rather dull blue-black, the apices of the second and third segments broadly aeneous, the second segment with a large aeneous triangle on each side connected with the posterior border; third and fourth segments each with a narrowly interrupted aeneous fascia lying before the middle, the inner ends carried forward, the outer ends of the fascia on the third segment connected along the lateral margin with the shiny apical fascia, the fascia on the fourth segment widening somewhat at the sides. The pile of the dorsum is yellowish white but it is much more dense on the aeneous fasciae, the side margins and on much of the fourth segment, giving a decided fasciate appearance to the abdomen. The pile on the venter is black with a wide wedge of pale pile on either side extending from the base to the end of the third sternite. The genitalia are shining black and bear black hair.

Types.—Holotype, male, Globe, Arizona, March. Paratypes: male, Globe, March, and male, Santa Catalina Mountains, Arizona, September. All the specimens were collected by Mr. Douglas K. Duncan to whom I am greatly indebted for the privilege of retaining the type and one paratype.

Spilomyia xanthocauda, new species

Related to *kahli* Snow, but with a reddish yellow vitta on each side behind the suture, the anterior ends curving inward and widely separated from the yellow spot on the notopleura; scutellum reddish yellow, not reddish brown; posterior femora black below, not above, and the face with a median reddish yellow vitta. Length, 12 mm.

FEMALE.—Front shining orange, the orbits very narrowly yellow pollinose on the lower two-thirds, the hair very short, yellow. Occiput black, cinereous pollinose, orange between the neck and vertex and more or less orange behind the mouth, the hair yellow. Cheeks brownish red, with a brown triangle above anteriorly. Face yellow, with a pale orange median vitta and inconspicuous yellow hair, the antennal prominence wholly shining orange. Antennae orange, the second segment about one-half longer than the first, the third slightly longer than wide, almost orbicular but a little flattened above.

Thorax subopaque black, very thinly cinereous pollinose, with orange markings as follows: the humeri and a large, contiguous triangle on their inner side, a small spot on the notopleura, a lunulate spot immediately in front of the scutellum, a sublateral vitta on each side behind the suture, the anterior ends curving inward and bordered outwardly by the reddish lateral margins, the scutellum wholly and an elongate oval spot on the posterior of the mesopleura. On the sternopleura and beneath the squamae are large yellow spots. The hair is black on the dark portions of the mesonotum, tawny on the reddish areas, pale yellowish on the pleura.

Legs reddish, the basal half of the tibiae yellow; posterior femora black beneath and posteriorly except basally and apically; hair pale, black only on the black portion of the femora.

Wings brown in front, cinereous hyaline behind, the costal cell luteous; the brown fills both basal cells, the broad base and most of the anterior border of the

discal cell and the broad base and broad anterior border of the apical cell. Squamae yellow; halteres reddish.

Abdomen black, yellow and reddish. First segment black with the sides broadly yellow. Second segment black with the sides and a large, sub-basal triangle on each side yellow, the triangles very narrowly separated in the middle, strongly widening toward the sides, the apex of the segment very narrowly reddish. Third segment similarly marked but the triangles are united, the black is replaced by brownish red on the posterior half of the segment and the apex is broadly yellow; fourth and fifth segments pale yellow; sternites blackish. Hair yellow, more or less brownish on the black dorsal areas.

HOLOTYPE.—Female, Globe, Arizona, October 10, 1934 (F. H. Parker).

The yellow bands on the abdomen are situated upon raised areas. The specimen was forwarded by Mr. D. K. Duncan.

Eristalis duncani, new species

A small species with black and gray vittate thorax and the eyes widely separated in the male. Length, 7 mm.

MALE.—Head black in ground color, the face reddish with a broad median stripe and the cheeks shining black. Eyes separated by a distance equal to the width of the wide ocellar triangle, the upper and lower parts separated by a subquadrate shining black spot; frontal triangle white pollinose with the middle more cinereous; vertical triangle grayish brown pollinose; frontal pile black, white on the sides of the frontal triangle. Occiput cinereous white pollinose, the hair white. Cheeks whitish pollinose on the posterior half; face thickly white pollinose and with white pile, produced downward, the tubercle rather large. Antennae shining brown, the third segment brownish red, as wide as long, convex above, the lower edge almost straight; arista ferruginous, bare.

Thorax gray pollinose, the mesonotum with four very broad black vittae, all broadly united behind the suture, the median pair separated by a gray line, the outer ones by half the width of the black median vittae; all of the black vittae are very broadly separated from the posterior margin; posterior calli dull black. Pile yellow, black on the posterior calli and scutellum, the latter dull reddish yellow with the narrow base and sides black.

Legs black, the coxae pale pollinose; anterior four legs with the tips of the femora, basal third of the front and half of the middle tibiae yellow, the tips of the posterior femora, basal half of the tibiae and the basal segment of the middle tarsi reddish, the narrow base of the posterior tibiae yellow. Hair black, yellow on the basal third of the upper surface of the posterior femora and a few yellow hairs on the tibiae. Posterior tibiae not produced at the apex, their femora moderately swollen.

Wings hyaline with slight luteous tinge. Squamae pale grayish with white base. Halteres pale yellow.

Abdomen opaque black, the rather broad apices of the second to fourth segments yellow. Second segment with a pair of very large, subtriangular aeneous spots, their outer ends produced broadly forward to the base of the segments, the sides of the segment black except in front. The third and fourth segments each bear an aeneous-black, shining fascia, very narrowly interrupted in the middle, narrow medianly, widening laterally, the third with the base opaque black except laterally, the fourth

with the opaque band narrow and limited to the median half; the opaque posterior band on the fourth segment is somewhat narrowed toward the sides. Pile yellow, black on the posterior opaque black bands, although the yellow pile may encroach upon them to some extent. Sternites blackish, with pale anterior and posterior margins.

HOLOTYPE.—Male, Phoenix, Arizona, August (D. K. Duncan).

This species is related to *furcatus* Wiedemann but is at once distinguished from this and allied species by the presence of four broad black mesonotal vittae.

Eristalis porteri, new species

Related to *elegans* Blanchard (*philippii* Schiner) but differs in having the oral margin broadly shining black and without pollen, largely black-haired posterior calli and the presence of black hairs posteriorly on the middle of the abdominal segments. Length, 9 to 11 mm.

MALE.—Head black in ground color, the face and broad anterior border of the frontal triangle brownish red, the lowest fourth or more of the face shining black. Frontal triangle moderately large, cinereous pollinose and black pilose, a large sharply arched area above the antennae without pollen or pile. Vertical triangle scarcely pollinose, with black hair in front and reddish yellow hair behind. Posterior orbits narrowly white, the pile short and white below, long and reddish yellow above, a few of the lateral occipital cilia black. Checks thinly white pollinose and yellow pilose. Face rather strongly produced downward, cinereous white pollinose on the pale portion, a median vitta extending over the tubercle bare and shining black or brown; pile yellow, black on the upper fourth or less. Antennae shining black, the third segment dark reddish, as wide as long, convex above, almost straight below, the upper edge and apex somewhat darkened; arista black. Eyes with rather long brown pile.

Mesonotum opaque black, on the anterior two-thirds with a pair of obscure brownish gray vittae and with a small spot of similar color on the inner ends of the suture. Scutellum reddish yellow with the very narrow base and sides black. Pile wholly reddish yellow except on the posterior calli where it is about half black. Pleura very thinly brownish gray pollinose and with yellowish pile.

Legs black, the tibiae rather ferruginous, becoming yellow at the base; tips of femora and basal segment of middle tarsi reddish. Hair reddish yellow, long on the femora.

Wings hyaline, with luteous tinge on the disc. Squamae pale yellow, halteres yellow.

Abdomen opaque, the first segment wholly black, the second yellowish red with a broad median black vitta that expands broadly in front; third segment similarly colored except that the black spot does not widen in front but is usually somewhat broadened behind; fourth segment black, with a broad, obscurely interrupted shining black fascia that widens laterally to reach the basal corners of the segment, the anterior border rather narrowly opaque; second to fourth segments with the posterior border narrowly yellow. Genitalia shining black. Pile reddish yellow, not dense, the disc with some black pile on the second and third segments apically, the third and fourth with some black hairs laterally toward the posterior border. Intermediate sternites yellow, the basal and apical ones black.

Types.—Holotype, male, and paratypes, two males, Chile. The specimens are probably from the vicinity of Valparaiso, one received from Dr. Carlos Porter.

This species will trace to *philippii* in my key published in American Museum Novitates No. 411.

OTITIDAE

EUXESTA LOEW

I have prepared a key to the species belonging to this genus, but several included in the genus by Hendel, in 'Genera Insectorum,' fascicle 106, are too poorly described to be placed.

Within the genus there is considerable variation in the shape of the head but the transition from those forms with scarcely a trace of antennal grooves and the face deeply concave in profile to those with deep antennal grooves and only slightly concave may be followed in the material before me. The typical species, *notata* Wiedemann, has the hair on the front rather scattered and is intermediate between the forms with banded wings, in which there are two definite rows of intrafrontal hairs, and the group with spots along the costa, in which the hairs are scattered. The group with fasciate wings has long, strong ocellars, while the others have these bristles, as well as the frontals, short. In the group having strong facial grooves the bristles of the head are weak. These approach *Acrosticta* Loew but the first vein is wholly bare apically while in *Acrosticta* it is haired apically or possesses at least a few spines. It is possible that *Euxesta maculata* Hendel belongs in *Acrosticta* while the species described by Cresson as *Acrosticta bicolor* is placed in *Euxesta*.

There is a possibility that the species placed in the genera related to *Euxesta* should be realigned and that those with long ocellars should be removed from the genus. If such a course is followed there is more reason for considering the species with deep antennal grooves as belonging to *Acrosticta*, despite the absence of spinules on the first vein and the absence of large frontal pits or grooves. This character does not seem to be a very good one for the separation of species into genera in this case, nor is the bristling of the first vein of much greater value, although it does serve to separate two major groups of genera. Thus, use of this latter character is undoubtedly a matter of utility rather than a natural one and its value cannot be denied.

The genera grouped around *Euxesta* are essentially tropical in distribution and only relatively few species occur in the United States. Until much more extensive collections are brought together it seems un-

wise to attempt any revision of the genera since the acquisition of additional material might disprove the conclusions reached from the study of a poorly known fauna.

Much of the following key has been adapted from Hendel and a number of the species are unknown to me except by description.

TABLE OF SPECIES

- 1.—Head with an opaque black spot between the antennae.....2.
Lunula not opaque black.....6.
- 2.—Wings with four brown cross-bands.....3.
Wings with two brown costal spots.....*maculata* Hendel.
- 3.—Marginal cell with a white spot beyond the third brown band.....5.
Marginal cell wholly brown beyond the base of the third brown fascia; front shining.....4.
- 4.—Legs almost wholly black.....*stigmatias* Loew.
Legs reddish.....*remota* Cresson.
- 5.—Front shining and swollen anteriorly.....*stigma* Hendel.
Front reddish, rather dull, not swollen anteriorly.....*eluta* Loew.
- 6.—Wings with brown spots or bands.....7.
Wings wholly whitish.....*lacteipennis* Hendel.
- 7.—Wings with only two or three brown spots or short bands or with the costal and subcostal cells wholly brown and the apical spot present.....40.
Wings with four brown fasciae or spots, or more extensively brown.....8.
- 8.—Wings brown with hyaline spots.....9.
Wings with four brown cross-bands.....11.
- 9.—Wings with many small hyaline spots.....10.
Wings with two short transverse white fasciae and an 8-shaped spot.
lunata Hendel.
- 10.—Scutellum, legs and abdomen yellow.....*fenestrata* Coquillett.
Body metallic greenish.....*geminata* Hendel.
- 11.—Abdomen wholly or partly yellowish or brownish red.....12.
Abdomen wholly dark in ground color.....15.
- 12.—Legs wholly yellowish.....*juncta* Coquillett.
Legs in large part blackish.....13.
- 13.—Pale wing-bands wider than the brown fasciae.....*major* Wulp.
Pale fasciae narrower than the brown bands.....14.
- 14.—Apical pale band bowed outward; posterior cross-vein in the middle of the third brown fascia.....*abdominalis* Loew.
Apical pale band transverse; posterior cross-vein near the inner edge of the third brown fascia.....*schineri* Hendel.
- 15.—Costa not produced near the middle.....16.
Costa produced forward near the middle.....*acuta* Hendel.
- 16.—Legs reddish or yellowish.....17.
Femora blackish.....21.
- 17.—Third and fourth brown fasciae connected anteriorly.....19.
Third and fourth brown fasciae separated from each other.....18.
- 18.—Third brown fascia broadening posteriorly.....*latifasciata* Wulp.

- Third brown fascia uniform in width.....*latifascia* Schiner.
- 19.—The brown apical fascia is much broader than the preceding white band.....20.
The brown apical fascia is narrower than the preceding whitish band.
- 20.—Pollen of the mesonotum cinereous and quite thick.....*conserta* Wulp.
Pollen of the mesonotum tawny.....*scoriacea* Loew.
schnuzei Hendel.
- 21.—Brown fasciae short, extending but little behind the fourth vein.....22.
At least one brown fascia extending to the fifth vein or beyond.....23.
- 22.—Base of the wing hyaline.....*quaternaria* Loew.
Base of wing brown.....*calligyna* Bigot.
- 23.—Apical brown band lying on the apex of the wing.....24.
Apical brown band lies before the apex of the wing.....*nigricans* Wulp.
- 24.—Third and fourth brown fasciae united anteriorly.....29.
Third and fourth fasciae not connected anteriorly.....25.
- 25.—Posterior triangle of the anal cell as long as the basal section of the cell.
bilimeki Hendel.
- Posterior triangle very much shorter than the basal section of the anal cell..26.
- 26.—The second brown band reaches only to the middle of the wing or slightly behind it.....*macquarti* Schiner.
The second brown fascia extends practically to the posterior border.....27.
- 27.—Base of the wing hyaline.....28.
Base of the wing brown.....*atripes* Loew.
- 28.—The two apical hyaline fasciae are much wider than the brown fasciae.
alternans Loew.
These fasciae are much narrower than the second and fourth brown fasciae.
alternata, n. sp.
- 29.—Apical brown fascia transverse on its inner side and entire, or convex and uniformly covering the apex of the wing.....30.
Apical brown band oblique on its inner side or incomplete.....33.
- 30.—Discal cell twice as long as the last section of the fourth vein..*acuticornis* Hendel.
Discal cell at most one-half longer than the apical section of the fourth vein.....31.
- 31.—The posterior cross-vein lies in the middle of the third brown fascia.....39.
The posterior cross-vein lies close to the inner edge of the third brown fascia.....32.
- 32.—Costal and subcostal cells wholly brown.....*arcuata* Hendel.
Only the apex of the costal cell brown.....*schnuzei* Hendel.
- 33.—Third brown fascia narrow anteriorly, very strongly widening behind.....34.
Third brown fascia at most slightly wider posteriorly than in front.....35.
- 34.—The brown apical band is narrower than the preceding hyaline fascia.
sororcula Wiedemann.
The brown apical band is broader than the preceding hyaline fascia.
obliquestrata Hendel.
- 35.—Base of the wing hyaline.....36.
Base of the wing blackish.....*insolita* Hendel.
- 36.—Face reddish, with scarcely any metallic coloration.....*annonae* Fabricius.
Face mostly metallic bluish in ground color, sometimes reddish below.....37.
- 37.—Third brown fascia uniformly brown.....38.

Third brown fascia very broadly gray or pale brown on its outer side.

fascipennis Wulp.

38.—Apical hyaline fascia very much wider than the apical brown band.

panamena, n. sp.

Apical hyaline fascia decidedly narrower than the apical brown band.

thomae Loew.

39.—Apical hyaline band extending into the marginal cell. *wettsteini* Hendel.

Apical hyaline band not extending in front of the third vein *tenuissima* Hendel.

40.—Wings with two fasciae extending to behind the fourth vein. *binotata* Loew.

The basal brown spot rarely extends behind the third vein, if reaching the fourth the apical spot does not do so. 41.

41.—Scutellum reddish¹. 42.

Scutellum metallic green, blue or black. 47.

42.—Thorax almost wholly reddish. 44.

At least the disc of the mesonotum blackish in ground color. 43.

43.—Only the scutellum reddish. *scutellaris*, n. sp.

Sides of the mesonotum and upper half of the pleura reddish; wings unusually wide. *contorta*, n. sp.

44.—Mesopleura almost all shining, a narrow pollinose band above. 45.

Mesopleura almost all pollinose, shining anteriorly. *rubida*, n. sp.

45.—Abdomen broadly reddish basally. 46.

Abdomen blackish basally, reddish apically. *lutzi*, n. sp.

46.—Sternum metallic greenish in ground color. *knowltoni*, n. sp.

Sternum reddish. *fervida*, n. sp.

47.—Abdomen with the base broadly reddish. 48.

Abdomen metallic, the apex and ovipositor sometimes yellow. 51.

48.—Costal cell brown. 49.

Costal cell hyaline on the apical half. *minor* Cresson.

49.—Third antennal segment little longer than wide. 50.

Third antennal segment decidedly longer than wide, scarcely wider than the second segment. 60.

50.—Apical brown spot beginning a little beyond the middle of the third costal section. *willistoni* Coquillett.

basalis Walker.

Apical brown spot beginning at the apical sixth of the third costal section.

abana, n. sp.

51.—Femora reddish or yellowish, except sometimes the front pair. 52.

All the femora blackish. 55.

52.—Face black, at least below. 53.

Face reddish. 54.

53.—Costal cell wholly brown. *apicalis* Williston.

Costal cell not brown. *nitidiventris* Loew.

54.—Front tarsi wholly black. *laticeps* Wulp.

Front tarsi with the basal segment mostly yellowish. *spoliata* Loew.

55.—Costal cell wholly brown. 61.

Costal cell mostly hyaline or only slightly darkened. 56.

¹ I am unable to place *compta* Cole, from Laguna Beach, Calif.

- 56.—Front largely reddish.....57.
 Front shining black.....*nigriceps*, n. sp.
 57.—Median brown spot extending to the fourth vein.....*costalis* Fabricius.
 Median brown spot not extending to the fourth vein.....58.
 58.—Apical spot lying before the apex of the wing.....*pusio* Loew.
 Apical spot touching the tip of the wing.....59.
 59.—Median brown spot extending to behind the third vein.....*mitis* Curran.
 Median brown spot not extending to the third vein.....*notata* Wiedemann.
 60.—Face luteous in ground color, rather thickly pollinose.....*xeres*, n. sp.
 Face black or dark brown in ground color, pale pollinose at least above.....62.
 61.—Knob of halteres whitish.....*pulchella* Cresson.
 Knob of halteres brown.....*magdalenae* Cresson.
 62.—Face almost wholly white pollinose; front black.....*sanguinea* Hendel.
 Face pollinose on upper half or less.....*bicolor* Cresson.

Euxesta abana, new species

Related to *willistoni* Coquillett but differing in having a smaller apical spot on the wing. The brown spot occupies less than the apical fifth of the third costal section, whereas in *willistoni* it occupies almost the apical half. Head pale orange, thorax metallic greenish black, the scutellum and apical abdominal segments bronzed or somewhat violaceous. Length, 4.25 mm.

MALE.—Head pale orange, the occiput black behind the eyes, the vertex with three black triangles, the lateral ones contiguous with the eyes, the median one covering the ocellar triangle. Front slightly shining, three-fourths as wide as one eye, with sparse, small punctures from each of which arises a short, black hair; two pairs of weak, reclinate frontals and a pair of weaker ocellars; verticals and outer verticals stronger than the frontals. Occiput below and the upper half of the face thinly white pollinose. Cheeks about two-fifths as wide as the eye-height, shining. Face broad, without distinct carina, the antennal grooves weak; antennae reddish, broadly separated, the third segment oval, a little longer than wide; arista brown, whitish at the base of the thinned section. Proboscis brown; palpi reddish, with black hairs.

Thorax shining greenish black, with just a trace of pollen inside the humeri. Scutellum bronze-black.

Legs reddish, the tarsi with the apical three segments wholly, and the broad apex of the third, brown.

Wings hyaline, milky only basally, the veins brown except basally; costal cell luteous, the subcostal light brown; apex of wing with dark brown spot extending from the costa to the fourth vein and beginning beyond the apical fifth of the third costal section. Squamae pale yellowish; halteres reddish.

Basal two abdominal segments and the basal half of the third shining dark reddish, the apical segments bronzed with strong violaceous reflections. Venter blackish green, reddish basally. Hair black, inconspicuous dorsally.

HOLOTYPE.—Male, Promontory, Utah, May 24, 1930 (G. F. Knowlton).

Euxesta rubida, new species

Rusty reddish, the thorax and abdomen thinly white pollinose; tarsi brown apically; mesopleura almost all pollinose. Length, 5 mm.

MALE.—Head shining, the occiput and less than the upper half of the face thinly white pollinose, the pollen extending along the frontal orbits for a short distance. Front about as wide as one eye, with sparse, very short black hairs arising from tiny punctures; only one pair of extremely weak frontals and ocellars; verticals, outer verticals and postocellars moderately strong. Cheeks one-third the eye-height. Face gently concave in profile, finely grooved on the lower half, the antennal grooves well marked. Proboscis and palpi reddish, with black hairs. Antennae reddish, the third segment oval, one-half longer than wide; arista brown, thickened on the basal sixth.

Thorax wholly reddish and thinly white pollinose, a bare shining stripe extending from the humeri to a point behind the front coxae, the scutellum and metanotum also shining. Hair very short, the mesopleura almost wholly haired.

Legs reddish, the apical two tarsal segments brownish.

Wings milky white, the veins yellow except apically and in front. Costal and subcostal cells brown, the apex of the wing with a brown spot extending from the apical seventh of the third section of the costa back to the fourth vein; apical cell at the tip only about one-third as long as the preceding costal section. Squamae white; halteres reddish with white knobs.

Abdomen reddish, thinly white pollinose; hair extremely short.

FEMALE.—Front slightly wider; apical segment of the ovipositor blackish.

TYPES.—Holotype, male, Corinne, Utah, June 22, 1929 (G. F. Knowlton and M. F. Bowen). Allotype, female, Delta, Utah, June 24, 1927, on beets (G. F. Knowlton). Paratypes: male, Lucin, Utah, August 12, 1929 (G. F. Knowlton); male, Phoenix, Arizona, August (D. K. Duncan).

Readily distinguished from any of the described species by its wholly reddish color and from the following by the mostly pollinose mesopleura.

Euxesta fervida, new species

Very similar to *rubida* but the abdomen is mostly black or brownish and the mesopleura is almost wholly shining. Length, 5 mm.

MALE.—Head orange, shining, the occiput thinly white pollinose except along the orbits, the middle of the face whitish pollinose on the upper third; antennal grooves well marked, the face finely wrinkled on the lower half. Front somewhat narrower than one eye, with sparse short hair, each hair arising from a tiny puncture; one pair of very weak orbitals and ocellars; vertical, outer vertical and postocellar bristles moderately strong. Cheeks in the middle about one-third the eye-height. Face gently concave in profile. Proboscis and palpi reddish, black-haired. Antennae reddish, the third segment elongate oval, two-thirds longer than wide; arista brown, thickened on the basal fifth, reddish at the base.

Thorax rusty reddish, thinly white pollinose, the mesopleura shining except on its upper margin; a pair of contiguous black spots extending from the neck to the dorsum on the anterior margin; scutellum and postnotum shining. Hair short, black, the mesopleura mostly haired.

Legs reddish, the apical two or three tarsal segments brown.

Wings milky white, less so apically, the veins yellow except in the brown areas; costal and subcostal cells brown; apex of the wing with a subtriangular brown spot extending from the costa to the fourth vein, its inner margin at the apical sixth of the

third section of the costa; end of the apical cell half as long as the preceding costal section. Squamae and knobs of the halteres white.

Abdomen shining black or brown, the basal two or three segments reddish, venter brownish red, reddish basally. Hair very short, black. Genitalia brown or reddish.

Types.—Holotype, male, Delta, Utah, July 12, 1930 (L. F. Clarke). Paratype, male, Delta, Utah, August 16, 1929 (G. F. Knowlton).

The holotype has the abdomen reddish brown with paler base, the paratype with the apical segments shining black. This species is readily distinguished from *rubida* by the shining mesonotum and more shining abdomen, more widely open apical cell, black mesonotal spots anteriorly, and the absence of whitish pollen on the sides of the face.

Euxesta knowltoni, new species

Wings whitish, the costal and subcostal cells and an apical spot brown; thorax red, the mesosternum mostly metallic black or green; abdomen red basally. Length, 4 mm.

MALE.—Head shining reddish, the occiput and upper half of the face thinly whitish pollinose; occiput with brownish spot on either side above the neck. Front narrower than one eye, the sparse black hairs arising from tiny punctures; the pair of frontals and ocellars extremely weak; bristles of the vertex rather weak. Cheeks about one-third as wide as the eye-height. Face very gently concave, finely wrinkled below; antennal grooves deep, the carina broad. Proboscis brown; palpi reddish, black-haired. Antennae reddish, the third segment with brown tinge, oval, one-half longer than wide; arista brown, thickened on basal sixth or less.

Thorax reddish, black in the middle anteriorly and on the mesosternum, thinly whitish or cinereous white pollinose; scutellum, metanotum, mesopleura except above, sternopleura above and the pteropleura shining, a blackish spot above the posterior coxae.

Legs reddish, the posterior tibiae with indications of a brownish band except below; apical two tarsal segments blackish.

Wings milky white, the costal and subcostal cells and an apical spot dark brown, the apical spot beginning at the apical sixth of the third costal section and extending back to the fourth vein; fourth vein ending distinctly before the tip of the wing. Squamae and halteres white.

Abdomen shining black with the basal two segments red; venter red with the apical two sternites black.

FEMALE.—Front slightly wider; dark spots on lower part of thorax rather greenish; basal three abdominal segments reddish yellow, the apex of the third broadly black, the fourth black with more or less metallic green tinge, the fifth dark metallic green, the ovipositor metallic green above, black below; venter reddish, dark apically.

Types.—Holotype, male, Trout Creek, Utah, July 26, 1933 (H. B. Stafford). Allotype, female, Randlett, Utah, July 14, 1927 (G. F. Knowlton).

The female apparently belongs with the male despite the difference in

color, although it may be found to represent a distinct species. There is a second male, without head or abdomen, taken by Mr. Knowlton at Timple, Utah, on June 4, 1930. In this specimen the black markings on the lower part of the thorax show a greenish tinge.

This species is related to *fervida* but differs in its smaller size, more slender form, and less widely separated antennae.

Euxesta lutzi, new species

Similar to *knowltoni* but the fourth vein ends slightly behind the tip of the wing; reddish, the abdomen brown; apical spot dark brown, costal cell luteous, the stigma brown. Length, 4.5 mm.

MALE.—Head reddish, face on a little more than the upper half, and the occiput except on the upper orbits, thinly white pollinose, the upper orbits with slight metallic reflection. Front about as wide as one eye, sparsely haired and with tiny punctures; two pairs of very weak frontals and a pair of very weak ocellars; bristles of the vertex rather weak. Cheeks a little more than one-third as wide as the eye-height. Face gently concave, finely wrinkled below. Proboscis and palpi reddish, the labellae brown. Antennae reddish, the third segment slightly more than twice as long as wide; arista brown, swollen on the basal fourth.

Thorax reddish, the bare parts with opalescent reflections; mesonotum, anterior and posterior borders of the pleura and the pectus thinly pale pollinose, the sternopleura pollinose on the anterior half.

Legs reddish, the tarsi scarcely darkened at their tips.

Wings whitish hyaline, the veins yellow except on the dark portions. Costal cell luteous, the subcostal cell brown; apical brown spot beginning at the apical fourth of the third costal section and extending back to the fourth vein; fourth vein ending slightly behind the tip of the wing. Squamae and knobs of the halteres white.

Abdomen brown, becoming more reddish apically, the basal segments almost black. Sternites shining brown, the incisures more or less pale. Hair black, inconspicuous. Genitalia reddish.

TYPE.—Male, Junta, Colorado, August 12, 1920 (F. E. Lutz).

Euxesta contorta, new species

A black and reddish species, the stigmatal cell considerably enlarged and the costa thickened and curved outward beyond the middle of the wing, the apical brown spot transverse. Length, 5.5 mm.

MALE.—Head reddish, the occiput and more than the upper half of the face thinly white pollinose. Front wider than one eye, with a transverse median depression and irregular sublateral depressions, but without pits or large punctures; hair short and very sparse; a pair of very weak frontals and ocellars; bristles on the vertex moderately strong. Cheeks in profile about one-third the eye-height, fully half the eye-height when viewed obliquely. Face scarcely concave in profile, the antennal grooves large and deep; finely wrinkled below. Proboscis brown, the palpi reddish. Hair black. Antennae reddish; third segment reddish yellow, twice as long as wide, the apex rounded; arista black, thickened on almost the basal third.

Mesonotum black with the sides broadly reddish, rather thickly cinereous white

pollinose. Scutellum shining reddish. Pleura reddish, mostly shining, the sternopleura, metanotum, and spots above the posterior coxae and on the pteropleura black, the lower and posterior third of the pleura whitish pollinose.

Legs reddish, the apical one or two tarsal segments brownish.

Wings hyaline, the veins yellow, black at the apex of the wing; costal cell somewhat yellowish, the subcostal cell mostly brown; stigmal cell brown, elongated and widened, the costa thickened beyond the apex of the subcostal vein, produced anteriorly on the apical third; apical brown spot transverse, reaching the costa only in the apex of the marginal cell. Squamae and halteres white.

Abdomen shining dark reddish, the fifth segment black. Hair inconspicuous, black.

HOLOTYPE.—Male, Iosepa, Utah, June 14, 1932 (G. F. Knowlton).

Euxesta scutellaris, new species

Head and base of abdomen reddish; thorax bronze-black with only the scutellum red. Length, 4 to 4.5 mm.

MALE.—Head dark reddish, the front sometimes mostly brownish red; occiput brown above the neck except on the broad posterior orbits, the antennal grooves more or less metallic blackish in ground color. Front somewhat narrower than one eye, with sparse short black hairs arising from tiny punctures; frontals and ocellars minute, the vertical bristles weak. Occiput and upper three-fourths of the face cinereous white pollinose. Cheeks a little more than one-third as wide as the eye-height. Face gently concave in profile, finely wrinkled below, the antennal grooves deep. Proboscis black; palpi reddish. Antennae reddish, the third segment mostly brown above, twice as long as wide, the apex rounded; arista black, thickened on the basal fifth, yellowish just beyond the thickening.

Thorax bronze-black, moderately cinereous white pollinose, the metanotum and the pleura except anteriorly and posteriorly, shining, often strongly violaceous, the pectus pollinose. Scutellum shining reddish.

Legs reddish, the tarsi becoming brown apically; posterior femora with a broad brownish stripe below.

Wings white, the veins yellow except on the dark areas; costal and subcostal cells and the apical spot dark brown; apical spot extending almost half way to the posterior cross-vein, and from the costa to the fourth vein; fourth vein ending in the wing-tip. Squamae and knob of the halteres white.

Abdomen shining metallic blackish green, the basal two segments dark reddish at least on the sides; venter bronze-black, dark reddish basally.

FEMALE.—The base of the abdomen shows scarcely a trace of reddish and the third segment is bronzed; ovipositor greenish, the under surface mostly black.

TYPES.—Holotype, male, Timpie, Utah, June 4, 1930. Allotype, female, Corinne, Utah, May 18, 1929. Paratypes; male, Skull Valley, Utah, July 24, 1929; male, Timpie, Utah, August 14, 1931; female, Delle, Utah, August 6, 1929, and male, Grantsville, Utah, August 6, 1929. All the specimens were collected by Mr. G. F. Knowlton.

Euxesta xeres, new species

Figure 1

Related to *basalis* Walker and *willistoni* Coquillett but at once distinguished by

the narrow third antennal segment. Base of the abdomen reddish, the thorax wholly dark. Length, 3.5 to 4 mm.

♂ MALE.—Head brownish red, the occiput blackish on the upper half; face and occiput with cinereous white pollen. Front a little narrower than one eye, with two pairs of orbitals, the anterior pair very weak, the upper about as strong as the ocellars; bristles on the vertex moderately strong; frontal hair sparse. Cheeks two-fifths as wide as the eye-height. Face scarcely concave in profile, finely wrinkled below, the antennal grooves deep. Proboscis brown; palpi reddish, black-haired. Antennae reddish, the third segment mostly brown, almost twice as long as wide; arista thickened on the basal sixth.

Thorax metallic blackish green, rather thickly cinereous pollinose, the middle of the pleura and the scutellum and notopleura shining.

Legs reddish, the femora usually in large part brown; tarsi blackish beyond the base of the second segment; tibiae sometimes extensively tinged with brown.

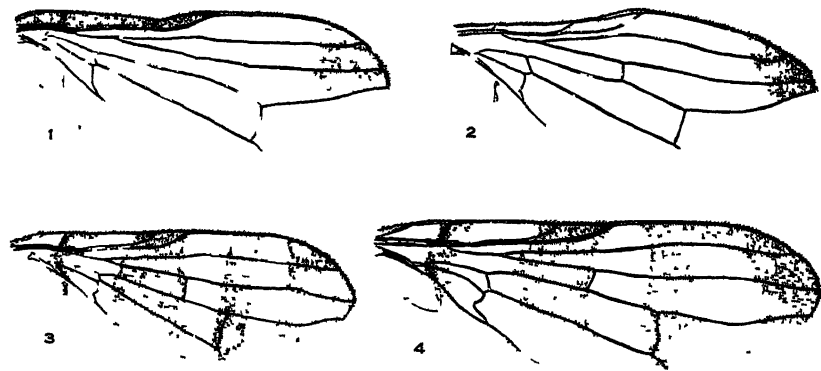


Fig. 1. *Euxesta zeres*, new species.

Fig. 2. *Euxesta nigriceps*, new species.

Fig. 3. *Euxesta alternata*, new species.

Fig. 4. *Euxesta panamena*, new species.

Wings whitish hyaline, the costal and subcostal cells and an apical triangle extending from the costa to the fourth vein and halfway to the posterior cross-vein brown; fourth vein ending slightly behind the tip of the wing. Squamae and the knob of the halteres white.

Abdomen metallic green, the basal two segments reddish, the third sometimes mostly black. Venter reddish basally, black apically, the genitalia black, sometimes bronzed.

FEMALE.—Front slightly wider, the ovipositor black.

TYPES.—Holotype, male, Corinne, Utah, June 18, 1929 (Knowlton and Bowen). Allotype, female, Corinne, June 5, 1929 (Knowlton). Paratypes: male, Corinne, June 22, 1929 (Knowlton and Bowen); male, Blue Creek, Utah, June 12, 1929; male, Clinton, Utah, June 11, 1930; male, Timple, Utah, June 4, 1930 (G. F. Knowlton); female, Snowville, Utah, June 20, 1930 (Knowlton and Bowen).

Walker's description mentions a "deep" third antennal segment for *basalis* so that these specimens cannot possibly be that species. In *willistoni* the third antennal segment is little longer than wide.

***Euxesta nigriceps*, new species**

Figure 2

Black, the abdomen metallic blackish green; tibiae mostly yellowish. Length, 3.5 to 4.5 mm.

MALE.—Head shining black, the face cinereous pollinose except below the antennal grooves. Front moderately shining, very sparsely haired, each hair arising from a tiny puncture; two pairs of weak frontals, the upper stronger than the ocellars; vertical bristles moderately strong. Occiput thinly cinereous pollinose except broadly along the upper orbits. Cheeks one-third as wide as the eye-height. Face scarcely concave in profile. Proboscis and palpi black. Antennae black, the third segment not wider than the second, two-thirds longer than wide, its apex rounded; arista thickened on the basal sixth.

Thorax blue-black, the dorsum metallic dark green, moderately cinereous pollinose; scutellum, metanotum and pleura, shining.

Legs black, the posterior four tibiae dull yellowish or yellow; tips of the femora, narrow base and apex of the front tibiae, basal two segments of the posterior four tarsi, and the immediate base of the front ones, reddish.

Wings whitish, with a brown spot apically, the spot extending from the costa to the fourth vein, its inner margin oblique, beginning at the apical sixth of the third section of the costa; fourth vein ending before the apex of the wing; costal cell scarcely darkened, the stigmal cell pale luteous, somewhat broadened, the costa slightly dilated. Squamae whitish; halteres yellowish, the knob somewhat brownish apically.

Abdomen dark metallic green, sometimes more or less bronzed. Hair black, inconspicuous.

Types.—Holotype, male, Delle, Utah, May 26, 1930. Paratypes: male, Timple, Utah, April 27, 1930; male, Vernon, Utah, June 15, 1929 (all G. F. Knowlton); male, Delle, April 27, 1930 (Knowlton and Janes).

***Euxesta alternata*, new species**

Figure 3

Related to *alternans* Loew but the apical brown fascia is much wider than the preceding white band. Length, 3.5 mm.

FEMALE.—Front about half as wide as one eye, the sides narrowly whitish pollinose, reddish yellow in ground color; upper third metallic blue-green except behind the ocelli, sides very thinly yellowish pollinose; four pairs of frontals, the upper pair strong and reclinate, three pairs of intrafrontals; ocellars long and strong; outer verticals very weak. Occiput bluish, becoming reddish below, cinereous pollinose. Cheeks about one-fifth as wide as the eye-height pale orange above, rather metallic below. Face deeply concave, metallic greenish blue, merging into reddish below, the sides reddish yellow, moderately white pollinose; clypeus brownish, more or less metallic, with reddish area in front. Proboscis metallic greenish; palpi yellowish red.

Antennae reddish yellow, the third segment mostly brown on the apical half; arista brown, long and thin, thickened and reddish at the base.

Thorax metallic blackish green; mesonotum thinly brown pollinose, the pleura with thin cinereous pollen; scutellum and metanotum shining dark brown. Two pairs of dorsocentrals.

Legs black; the knees and tarsi yellowish; anterior coxae reddish yellow, the others brownish red.

Wings with alternate white and brown bands, the posterior border gray (Fig. 3). Squamae and knobs of the halteres white.

Abdomen metallic green-blue on the sides and ovipositor, the dorsum shining dark brownish, possibly wholly blue in most specimens. Venter brown with blue reflections except basally. Hair black, the apical three segments each with a row of weak marginals.

HOLOTYPE.—Female, Barro Colorado Island, Canal Zone, February 18, 1929 (Curran).

I have a male from Costa Rica that might belong with the female. It differs in having six pairs of frontals, four pairs of intrafrontals, much darker coxae, a wider, white preapical band on the wings and the abdomen is more evenly bluish. The vertex is unusually shining in this species, whereas, in *alternans*, it is moderately thickly pollinose.

Euxesta alternans Loew

Loew, 1867, Berl. Ent. Zeitschr., XI, p. 308 (f.).

I took three specimens of this species from a fallen banana stalk on Barro Colorado Island on December 21 and 28, 1928. They were very active but did not take to flight readily, when doing so dodging downward so that their capture was difficult. Mr. Herbert F. Schwarz captured a single female at Summit, Canal Zone, on November 26, 1930. We have additional material from British Dominica and Brazil.

Euxesta panamena, new species

Figure 4

Perhaps related to *schnusei* Hendel but with white squamae and very light yellow halteres. Length, 5 mm.

FEMALE.—Front about two-thirds as wide as one eye, reddish, the vertex with three long, bluish triangles, the sides whitish pollinose, the vertex with cinereous yellow pollen; about seven pairs of frontals, the upper pair strong and reclinate; four pairs of intrafrontals; ocellars and outer verticals long and strong. Occiput bluish in ground color, rather thickly cinereous white pollinose; a reddish area above the neck. Cheeks and parafacials reddish yellow, the latter white pollinose, the cheeks rather metallic below. Middle of the face bluish green, thickly white pollinose on the upper three-fifths, strongly concave in profile. Clypeus bluish on the sides, reddish in the middle. Proboscis blue-green; palpi broad, dark reddish. Antennae reddish, the third segment brownish red on the apical half; arista brown.

Thorax black, the pleura blackish green; thickly pollinose, the pleura with cinereous pollen and moderately shining on the upper half, the mesonotum with cinereous brown pollen and a large blackish area on each side behind the suture; scutellum and metanotum shining bronze-black.

Legs black, the knees and tips of the tibiae reddish; anterior coxae reddish, the others with reddish tips; basal segment of middle tarsi obscurely reddish basally.

Wings (Fig. 4) whitish and brown, the posterior border grayish.

Abdomen blue-black, the apex and ovipositor more brownish; base narrowly greenish above. Hair black, the apices of the second to fourth segments with short bristles.

HOLOTYPE.—Female, Barro Colorado Island, Canal Zone, January 3, 1929 (Curran).

PALLOPTERIDAE

Omomyia regularis, new species

Differs from the male of *hirsuta* Coquillett in having the scutellum of ordinary shape, the hair black, and the costal and subcostal cells black. In color rather similar to the female of *hirsuta* but more ferruginous. Length, about 5 mm.

MALE.—Head shining dark reddish, the occiput dulled by whitish pollen; face dull yellowish in the middle, white pollinose. Front distinctly narrowing anteriorly, with long hair, on either side with a row of six weak proclinate frontals and a strong, reclinate one above; ocellars and bristles of the vertex long. Cheeks a little more than one-third as wide as the eye-height, with black hair on the lowest two-thirds. Proboscis reddish, brown below; palpi pale reddish. Antennae reddish, the third segment broadly brown above; arista black, dark reddish basally.

Thorax blackish and dark reddish. Mesonotum with three very broad, narrowly separated black vittae (mostly blackish), the pleura very broadly black in the middle and below; pollen whitish, mostly limited to the black areas, almost absent on the mesonotum except in front; metanotum shining black; scutellum shining reddish. Hair black, moderately long and abundant, the bristles limited to the sides and a prescutellar row; scutellum bare except for the two pairs of strong marginals, gently convex.

Legs reddish, the tibiae mostly ferruginous, the tarsi reddish with the apical two or three segments black. Hair black, abundant and moderately long on the femora.

Wings hyaline, the extreme tip obscurely white; costal and subcostal cells dark brown; apex of the second vein surrounded by a small blackish spot; veins black, yellow basally except in front, and on the apex of the wing, the third and fourth veins convergent apically. Squamae and halteres white.

Abdomen shining black, the basal two segments dark reddish. Hair abundant, moderately long. Genitalia small.

HOLOTYPE.—Male, Globe, Arizona, March (D. K. Duncan).

The color of the thorax will no doubt be found to be somewhat variable, so I have not described it in detail.

TACHINIDAE

Sturmia balloui, new species

Traces to *inquinata* Wulp in Coquillett's key (1897) but differs in having a large, dense sexual patch on each side of the under part of the third tergite and the sides of the abdomen reddish. Length, 8 to 8.5 mm.

MALE.—Head black in ground color, white pollinose, front and the posterior orbits on the upper half or more with strong golden yellow tinge. Front about two-thirds as wide as one eye, the parafrontals at the middle wider than the frontal vitta; eight or nine pairs of frontals and a partial secondary row, the upper two reclinate; hair short and not abundant; orbitals and ocellars absent; outer verticals not developed. A row of black hairs behind the occipital cilia on the lower half of the head, the occipital hair white. Cheeks about one-fifth as wide as the eye-height, with black hair. Parafacials narrowing below where they are more than half as wide as the third antennal segment; facial ridges bare except adjacent to the vibrissae. Palpi black, the apex more or less reddish below. Antennae black, thinly cinereous pollinose, the incisures reddish, reaching almost to the vibrissae; third segment of moderate width, with parallel sides, the apex subtruncate; arista long and slender, thickened on the basal third and microscopically pubescent.

Thorax cinereous pollinose; mesonotum with four narrow, blackish vittae. Four postsutural dorsocentrals and sternopleurals. Scutellum reddish yellow in ground color, the base darkened; four pairs of marginals, the apical pair decussate.

Legs black, the posterior tibiae evenly ciliate anterodorsally, one of the bristles long; middle tibia with a single anterodorsal bristle; pulvilli as long as the apical tarsal segment.

Wings cinereous hyaline; third vein with a single basal bristle.

Abdomen black, the sides of the second and third segments reddish, cinereous pollinose, the first segment, apices of the following segments and a narrow median vitta rather shining, thinly brown pollinose. First and second segments each with a pair of median marginals, the third and fourth each with a row, the fourth with some scattered, short discals, particularly posteriorly. Under side reddish on the second and third tergites, the third with a large, rectangular sexual patch covering most of its surface.

TYPES.—Holotype, male, and three male paratypes, San Pedro de Montes de Oca, Costa Rica, September 15, 1932 (Edgar Ortiz); received from Charles H. Ballou. The species was reared from the pupa of a sphingid.

TABLE OF SPECIES OF THE MALES OF *Lixophaga* TOWNSEND

- | | |
|--|--------------------------|
| 1.—With one or two pairs of proclinate orbital bristles..... | 2. |
| Without orbital bristles..... | 7. |
| 2.—With two pairs of orbital bristles..... | 3. |
| With a single pair of orbitals situated almost in the frontal row. | |
| | <i>impatiens</i> Curran. |
| 3.—Parafacial below much narrower than the third antennal segment..... | 4. |
| Parafacial as wide as the third antennal segment or practically so; pulvilli very small..... | <i>plumbea</i> Aldrich. |
| 4.—Pulvilli small..... | 5. |
| Pulvilli almost as long as the fifth tarsal segment..... | <i>fasciata</i> Curran. |

- 5.—Parafacials, below, about three-fourths as wide as the third antennal segment.
orbitalis Aldrich.
- Parafacials less than half as wide as the third antennal segment.....6.
- 6.—Parafacials about one-fourth as wide as the third antennal segment; apical cell closed in the wing-margin.....*jennei* Aldrich.
- Parafacials almost half as wide as the third antennal segment; apical cell open.
mediocris Aldrich.
- 7.—Sides of the abdomen broadly reddish.....*diatraeae* Townsend.
- Abdomen wholly blackish.....8.
- 8.—Front more than half as wide as one eye.....9.
- Front much less than half as wide as one eye.....10.
- 9.—Pale abdominal fasciae narrow and sharply limited; front golden yellow.
stenomae, n. sp.
- Pale abdominal pollen occupying at least the basal half of the intermediate segments and not sharply limited, the hairs arising from dark spots.
parva Townsend.
- 10.—Veins at the base of the wings broadly yellowish.....*variabilis* Coquillett.
- Veins at the base of the wings black; squamae brownish; front very narrow.
nigribasis Curran.

Lixophaga stenomae, new species

Black, the palpi and halteres yellow; abdomen rather narrow cinereous fasciate. Length, 5 to 5.5 mm.

MALE.—Front a little more than half as wide as one eye, golden pollinose, the frontal vitta deep black; ten pairs of frontals, the upper two reclinate, the next to the upper pair very strong; a row of tiny hairs on the parafrontals; ocellars long; outer verticals not clearly differentiated. Occiput cinereous white pollinose, the orbits golden yellow on the upper half, the black occipital cilia extending to the lowest fourth of the eye; pile white. Cheeks about one-fifth as wide as the eye-height, black-haired. Parafacials narrow, slightly widening above. Palpi dull yellowish. Antennae black, the third segment missing.

Mesonotum with golden-yellow pollen, the vittae distinct; acrosticals and dorso-centrals 3-3; three pairs of marginal scutellars and a very weak, decussate apical pair; sternopleurals 2-1. Scutellum golden-yellow pollinose on more than the apical half, brown basally.

Legs black, the pulvilli of median length.

Wings cinereous hyaline, lightly tinged with brown in front. Apical cell ending a little before the wing-tip. Squamae whitish. Halteres yellow.

Abdomen shining black, the basal third of the segments cinereous-yellow pollinose above, cinereous pollinose ventrally where the pollen expands to occupy most of the under surface; on the fourth segment the pollinose fascia is narrow in the middle but expands strongly toward the sides. Abdomen without discals, the first and second segments each with a pair of marginals, the third and fourth each with a row.

FEMALE.—Front a little wider, gradually widening anteriorly, with two pairs of orbitals; outer verticals well developed; third antennal segment reaching almost to the vibrissae, moderately wide; arista thickened on the basal fourth, short pubescent.

Pollinose abdominal bands wider, those on the second and third segments widened in the middle.

Types.—Holotype, male, and allotype, female, San Pedro de Montes de Oca, Costa Rica, September 15, 1932 (C. H. Ballou), ex *Stenoma* species on avocado.

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NEW ASILIDAE FROM THE SOUTHWESTERN UNITED STATES (DIPTERA)

BY A. EARL PRITCHARD¹

One new genus and fourteen new species of Asilidae, from Arizona, New Mexico, and Oklahoma, as well as keys to several genera, are given in this paper. I am indebted to Dr. C. H. Curran for checking most of this new material. The types of the new species are deposited in The American Museum of Natural History.

OMNINABLAUTUS, NEW GENUS

Form and structure as in *Ablautus* Loew, and separated from the other Nearctic genera of Dasypogoninae lacking pulvilli, *Hodophylax* James and *Parataracticus* Cole, by *Ablautus* characters. Differs from *Ablautus* by possessing a terminal clawlike spur on the fore tibia, and in view of this spur somewhat allied to *Hodophylax*. The relationship of *Omninablautus* to *Ablautus* is parallel to that of *Comantella* Curran and *Eucyrtopogon* Curran.

Head nearly twice as broad as high. Face and front moderately wide, their sides subparallel, slightly and broadly convergent below level of antennae. Mystax dense, reaching nearly to the antennae and concealing the flattened face. Antennae short and slender; basal two segments short, subequal, bearing long bristles below; third segment one and one-half times as long as the first two combined; style short with a tiny apical spine. Ocellar tubercle large and bristly. Thorax quite bristly; hind margin of scutellum with several pairs of bristles. Abdomen rather narrow, convex dorsally, gently tapering; segment one very short, segment three with a transverse furrow near base. Male genitalia small; ovipositor with a terminal circlet of spines. Legs bristly; terminal spur of front tibia long and crooked; claws long and slender; pulvilli absent. Wings with posterior cells widely open, the anal cell closed at the margin.

GENOTYPE.—*Omninablautus arenosus*, new species.

Omninablautus arenosus, new species

Black in ground color, the abdomen, except base, and legs for the most part reddish; pollen and vestiture white or yellowish. Length, 5 to 8 mm.

MALE.—Head densely white pollinose, yellowish above occipital foramen. Antennae black with basal segments reddish inside; thinly covered with pollen. Rear of head with a row of white occipito-orbital bristles, the lower sides of the occiput pilose.

Thorax thickly cinerous pollinose; pronotum, mesonotum behind the transverse

¹ Oklahoma Agricultural and Mechanical College.

suture, and scutellum yellowish pollinose; bisected by a row of white hairs and bordered on either side by a row of long yellowish bristles. Scutellum with two to four pairs of bristles on the hind margin.

Coxae colored like the thorax, legs otherwise yellowish; trochanters and tarsi brownish; apices of the tibiae dark brown. Legs covered with white bristles and large appressed hairs; claws, terminal spur on front tibiae, and apical spine on middle tibiae, black.

Wings hyaline, veins yellow basally.

Abdominal segments 1-3, except front border of 2 and a pair of large basal spots on 4, black, otherwise reddish; 2-6 completely covered with silky white pollen; 7, 8, and appendages shining. Sides of abdomen bearing stout setae, 2 and 3 with lateral bristles. A double transverse row of small black spots in the furrow across base of 3; an indentation usually present across beveled base of 2.

FEMALE.—Similar to the male, usually larger. Posterior margin of abdominal segment 3 usually red in ground color, basal black spots on 4 reduced and widely separated, or absent. A pair of basal, non-pollinose semicircular spots present on 4 and 5, less widely separated on the latter segment; 6-8 shining except lateral pollinose margins of 6; spines of ovipositor black.

Types.—Holotype, male, Artesia, New Mexico, August 30, 1934 (A. E. Pritchard). Allotype, female, same data as holotype. Paratypes: 8 males, 5 females, same data.

This fast-flying little species was taken on bare stretches of sand in company with *Hodophylax aridus* James, and the apiocerid, *Apiocerus augur* Osten Sacken.

HETEROPOGON LOEW

TABLE OF SPECIES

- 1.—Scutellum and face yellow..... *vespoides* Bigot.
Scutellum and face black in ground color..... 2.
- 2.—Basal four abdominal segments wholly black in ground color..... 3.
Third and following segments mostly reddish or with the apices broadly reddish..... 12.
- 3.—Wings brown on the apical half..... 4.
Wings never wholly brown on the apical half..... 5.
- 4.—Mesonotal vittae dull blackish..... *macerinus* Walker.
Mesonotal vittae shining..... *phoenicurus* Loew.
- 5.—Wings brownish on the basal half or more..... *ludius* Coquillett.
Wings either pure hyaline or with the cross-veins and furcations brown..... 6.
- 6.—Wings wholly hyaline..... 7.
Wings with the cross-veins clouded..... 10.
- 7.—Abdomen cinereous except the genitalia..... *wilcoxi* James.
Abdomen not wholly cinereous..... 8.
- 8.—Abdomen with the segmental apices broadly cinereous pollinose. *latus* Loew.
Apices of the segments at most pollinose laterally..... 9.
- 9.—Veins yellowish; abdominal segments whitish pollinose posteriorly
johnsoni Back.

Veins brown; dorsum of the abdomen black-haired except at the sides.

- senilis* Bigot.
- 10.—Legs black; mystax black below.....*nigripes* Jones.
Tibiae reddish yellow.....11.
- 11.—Mystax wholly white.....*paurosomus*, n. sp.
Mystax black on at least the lower half, wholly black in the male. *currani*, n. sp.
- 12.—Abdominal segments black with the apices broadly reddish.
rubrifasciatus Bromley.
Abdomen differently colored, usually mostly reddish with blackish
spots laterally.....13.
- 13.—Wings almost uniformly smoky gray; first segment of front tarsus of
male without dense white pile.....*rubidus* Coquillett.
Wings brownish, darker on the apical half; basal segment of front tar-
sus of male bearing dense, white pile.....14.
- 14.—Anterior four femora black except at apex.....*patruelis* Coquillett.
Anterior four femora yellowish below, black above.....*spatulatus*, n. sp.

This key was kindly drawn up by Dr. C. H. Curran, in whose honor I have named the following species.

Heteropogon currani, new species

Black; tibiae and tarsi reddish; head, thorax, and sides of abdomen brown and gray pollinose. Wings hyaline, the cross-veins clouded. Length, 10 to 17 mm.

MALE.—Head brown pollinose, the pollen of the posterior orbits dense, light yellowish. Antennae, palpi, and proboscis black. Pile and bristles of front, face, antennae, and palpi black. Mystax above thinly pilose, rarely with a few white hairs; bristly below. Ocellar bristles yellowish; occipito-orbital bristles usually for the most part black; rear of head densely white pilose.

Thorax brown pollinose, covered with white pile. Three broad stripes on mesonotum darker, but little differentiated; median stripe long, usually divided in front, interrupted behind; lateral stripes shorter, narrowly interrupted at the transverse suture. The area in front of the lateral stripes on each side of the median stripe is usually lighter and notably pilose. Pleurae and coxae cinereous pollinose. Mesonotal bristles long, black or yellow. Scutellum white pilose on apical half, its margin with two pairs of bristles.

Legs black, tibiae and tarsi reddish. Femora black-haired above, white pilose beneath; tarsi black-haired, the metatarsi above sparsely clothed with appressed silvery hairs. Black brush present on middle tibia, small and occasionally reduced to a few black scalelike setae.

Wings hyaline, extreme base brown as far as humeral veinlet, cross-veins and furcations clouded with brown.

Abdomen black; brown pollinose on lateral margins of 2-6, and rarely extending across the dorsum as a narrow basal line; lateral apices of 2-5 or 6 triangularly gray pollinose, often with a yellow tinge. Tergum with short black setae; lateral apices and rarely posterior margins of 2-5 yellow setiferous; lateral margins and venter white pilose, thick basally. Appendages, segments 8 and 7 often reddish brown.

FEMALE.—Similar, upper half of mystax, hairs of front, and all of occipito-orbital

bristles white or pale yellowish. Black brush on middle tibia lacking. Ovipositor shining black.

Types.—Holotype, male, Stillwater, Oklahoma, October 8, 1934 (A. E. Pritchard). Allotype, female, same data. Numerous paratypes, September 15–October 29, Stillwater (A. E. Pritchard).

Found abundantly on the tips of dead twigs, feeding mostly on chinch bugs. Males were seen more often with their face in the abdominal plumose hairs and anal spines of the female than in copulation. Several ovipositing females were observed on the ground under the trees. A suitable place was carefully felt out with the abdomen and the ovipositor worked into the loose loam. After laying a single egg, the ground was patted down with the tip of the abdomen and a new locality selected near by.

Heteropogon paurosomus, new species

A small unique species sharing with *currani* the black body and hyaline wings with clouded cross-veins. Length, 8 to 9 mm.

MALE.—Head covered with white pollen except vertex which is brown pollinose. Hair and bristles of head white; mystax rather dense, silky above; rear of head moderately pilose. Antennae black, brown pollinose; style short, two-thirds the length of segment 3.

Thorax light gray pollinose, the three mesonotal stripes broad and dark, brown pollinose except median stripe anteriorly. Clothing of thorax white with the pronotal, posterior mesonotal, and scutellar bristles black, or all wholly white. Scutellum in part shining black, without hairs; two pairs of bristles on the posterior margin.

Legs black, apices of femora, tibiae, and tarsi yellowish red, the tarsi brown apically. Femora white-haired above, nearly bare below. First tarsal segments thinly clothed above with appressed white hairs, the fore metatarsi with additional longer and denser white hairs externally. Spines of tibiae for the most part white, those of tarsi mostly black. Middle tibiae without black brush.

Wings hyaline, the cross-veins and furcations, especially costally, clouded with brown.

Abdomen shining black with a bluish tint, the genitalia, segment 8, and the posterior borders of apical segments reddish, or entirely black. Dorsum moderately clothed with short white hairs. Sides of segments 2–5 beset with short white spines; lateral apical corners of these segments with a patch of white pollen. Sides and venter white pilose, that of apical segments often yellow.

FEMALE.—Similar, clothing of abdominal tergum scant, and clouding of wings more extensive.

Types.—Holotype, male, Tuscon, Santa Catalina Mts., Arizona, August 22, 1934 (A. E. Pritchard). Allotype, female, same data as holotype. Paratypes: 1 male, 1 female, same data; 4 males, Oracle, Arizona, August 23, 1934 (A. E. Pritchard).

The Tuscon specimens were taken with *Buckellia*, occurring on the tips of dead twigs in the usual *Heteropogon* fashion.

***Heteropogon spatulatus*, new species**

Thinly pilose; abdomen and legs largely yellowish; abdomen spatulate in male. Length, 10 to 11 mm.

MALE.—Head black, covered with whitish or pale yellow pollen and clothed with white hairs and bristles, the front, however, brown pollinose and black-haired. Mynstax thinly pilose, oral margin with much longer bristles. Rear of head moderately pilose with a few scattered black hairs.

Thorax gray pollinose; three broad mesonotal stripes dark, brown pollinose, the middorsal stripe especially contrasting. Pile sparse, the dorsum nearly bare. Bristles all or for the most part white. Scutellum except pollinose base, polished blue-black, with a single pair of marginal bristles.

Legs yellowish red, anterior four femora black above, posterior femora black on apical two thirds, paler ventrally; tibiae darker apically, the posterior tibiae stout, nearly black on ventral half and apex; tarsi with apical segments dark brown; Femora thinly white-haired above, nearly bare below; tibial bristles black and white; tarsal clothing black except fore metatarsi which have appressed white hairs above, and a dense, long white brush externally. Middle tibiae with anterior side densely white-haired, a conspicuous black patch just below the middle.

Wings hyaline on basal half, brownish on apical half except an area through discal cell and third and fourth posterior cells which is clear.

Abdomen for the most part yellowish, segment 1 and a dorsal pair of extreme basal spots on 2 shining metallic blue-black; sides of 2-6 marked with black, more extensive posteriorly; dorsum of 5 and 6 and small basal spot on 7 brownish. Dorsum and sides sparsely setiferous, the setae on 1-3 and 8 yellow, on 4-7 nearly all black. Sides on 1, lower margin and apical triangle on other segments white pollinose, though small on 6-7; venter 1-4 white pollinose. Sides of 1 white pilose and bristly, abdomen otherwise with but a few long hairs on lateral margins and venter.

FEMALE.—Similar to the male, but a greasy specimen. The abdomen is not coarctate and the apical half of the wings is smoky gray rather than brownish. Front white-haired. The abdomen has a dorsal triangle on basal three-fourths of segment 2, colored similar to 1; bases of 3-5 and apical spot on 8 brown; 5-6 not darker than other segments. Spines of ovipositor black.

TYPES.—Holotype, male, Hayden, Arizona, August 20, 1934 (A. E. Pritchard). Allotype, female, Oracle, Arizona, August 23, 1934 (A. E. Pritchard).

The male was taken in the shade of the trees on the banks of the Gila River in company with *Ommatius maculatus* Banks, whose general habits it seemed to share.

BUCKELLIA CURRAN

A little known southwestern group of this genus is characterized by having the abdomen black in ground color with the first five segments

wholly pollinose. The following key will separate members of this group. *Buckellia clausa* Coquillett, which is not included although the abdomen of the female is pollinose for the most part, may be distinguished by having the tarsal segments yellow basally rather than black.

- 1.—Anterior calli bearing five or six bristles.....*drakei*, n. sp.
Anterior calli only pollinose.....2.
- 2.—Scutellum with a single pair of marginal bristles.....3.
Scutellum with more than two marginal bristles.....5.
- 3.—Pollen of abdomen uniformly cinereous.....*stylosa* Curran.
Pollen of abdomen brown on dorsum.....4.
- 4.—Dorsum of abdomen uniformly brown pollinose.....*hesperia*, n. sp.
Dorsum of abdomen brown pollinose with segmental apices broadly cinereous.....*pollinosa* Curran.
- 5.—Fore tibiae black.....*vera*, n. sp.
Fore tibiae reddish yellow on basal three fourths.....6.
- 6.—Abdomen with dorsum uniformly brown pollinose.....*lutzi* Curran.
Abdomen cinereous pollinose with dorsal brown fasciae, male, or indications of such, female.....*wilcoxi*, n. sp.

Buckellia drakei, new species

Black, cinereous and rusty-brown pollinose, the abdomen with brown fasciae; anterior tibiae in part reddish yellow. Length, 8 mm.

MALE.—Head cinereous pollinose, vertex thinly so and with a brownish tinge; face and posterior orbits silky white. Oral margin with a row of white bristles forming the small mystax, face with fine white hairs scattered nearly to the antennae.

Thorax cinereous pollinose, mesonotum with median stripe and three large spots on either side rusty brown. Dorsum with conspicuous appressed white hairs; bristles yellowish, the anterior calli bristly. Scutellum with 2 pairs of marginal bristles.

Legs black; middle tibiae brownish basally; fore tibiae with basal two thirds reddish yellow. Clothing of legs white except for black ventral bristles on tarsi.

Wings hyaline, tinged with flavesence on apical half.

Abdomen wholly pollinose, base of segment 2, basal two thirds of 3-7, and 8 brown; dorsum otherwise, lateral margins and venter cinereous. Setae on dorsum brown, on sides white; bristles of diminishing size on sides of 2-4.

HOLOTYPE.—Male, Oracle, Arizona, August 23, 1934 (C. J. Drake).

This species is named in honor of its collector, Dr. Carl J. Drake, who made possible the collection of most of the material for this paper.

Buckellia stylosa Curran

CURRAN, 1931, Amer. Mus. Novit., No. 487, p. 7.

Black, uniformly cinereous pollinose; mesonotal vittae bare, shining black; apex of femora and tibiae except apex, reddish yellow. Known previously from a single female from Woods Co., Oklahoma. I have found this species in numbers in the panhandle near Boise City where it

was seen on tall dead weeds along the river sands, but not associated with the tip of bare twigs like other species of this group. The male is similar to the female, the abdomen wholly pollinose in this sex. The antennal style in this species is somewhat variable and is usually but a little longer than the first segment.

***Buckellia pollinosa* Curran**

CURRAN, 1930, Amer. Mus. Novit., No. 415, p. 10.

Black, gray pollinose; abdomen with dorsum brown pollinose, the sides broadly and the broad apices of the segments gray pollinose; wings hyaline or with a brownish-yellow tinge. Known from the mountains of southern Arizona.

***Buckellia hesperia*, new species**

Similar to *pollinosa* Curran, but the thorax more coarsely pollinose, the abdomen uniformly brown pollinose above, and the wings yellowish brown on apical half. The pale pollen has a bluish tinge. Length, 8 to 10 mm.

MALE.—Head black, covered with cinereous pollen, thin on vertex, shining white on face. Mystax a single row of oral bristles. Hairs of face sparse and very small; occipital hairs very fine; occipito-orbital bristles weak.

Thorax black, bluish-gray pollinose. Mesonotum with the median stripe, which is widened in front, abbreviated behind, and two isolated spots on each side brown, sparsely clothed with short, unnoticeable, white setae and a few white bristles posteriorly. Each posterior callus with a single long bristle, hind margin of scutellum with a pair of small bristles.

Legs black, basal three-fourths of tibiae reddish yellow; clothing white or pale yellowish.

Wings hyaline, the apical half yellowish brown although the tip is paler.

Abdomen wholly pollinose, color of dorsum uniformly brown; broad sides and venter concolorous with thoracic pleurae.

FEMALE.—Similar, dorsum of abdominal segment 7 and all of 8 shining black.

TYPES.—Holotype, male, Tuscon, Arizona, August 22, 1934 (A. E. Pritchard). Allotype, female, same data as holotype. Paratypes: one male and one female, same data.

***Buckellia lutzi* Curran**

CURRAN, 1931, Amer. Mus. Novit., No. 487, p. 7.

Black, covered with cinereous pollen, mesonotal vittae and dorsum of abdomen brown; scutellum bearing six marginal bristles; tibiae reddish yellow on basal three-fourths. Described from a single male, Regnier, Colorado (extreme end of Oklahoma panhandle), and recorded from Texas by Bromley.

Buckellia vera, new species

Very similar to *lutzi* Curran, differing mainly by the legs being nearly all black. The hind margin of the scutellum has typically two pairs of bristles instead of three, although one specimen has an imperfectly formed third pair. Length, 8 mm.

FEMALE.—Head cinereous white pollinose, front and vertex tinged with brown. Mystax a single row of white bristles; fine hair sparsely scattered over face. Antennae black, thinly gray and brown pollinose; style strongly tapering and yellow on apical half.

Thorax gray pollinose, mesonotal vittae brown; median stripe widened in front, abbreviated behind; lateral stripes short, divided at the transverse suture.

Legs black with base of middle tibiae and basal half of hind tibiae dark reddish brown.

Wings hyaline with the apical half tinged with yellow. Halteres yellowish.

Abdomen cinereous pollinose with the upper surface uniformly brown except dorsum of segment 7 and all of 8 which is bare and shining black.

TYPES.—Holotype, female, Tuscon, Arizona, August 22, 1934 (A. E. Pritchard). Paratype, female, same data.

Buckellia wilcoxi, new species

Similar to *lutzi* Curran, but the apices or most of the dorsum of the abdominal segments grayish like the sides and venter. The antennae are slenderer than in either *lutzi* or *vera*. Length, 8 mm.

MALE.—Head cinereous pollinose, thinner on vertex; mystax composed of several mixed rows of long bristles and hairs; hairs on face longer than usual. Antennae black, brown and white pollinose; style with apical half yellowish.

Thorax grayish pollinose, brownish on dorsum. Three mesonotal stripes with pollen worn off, but not the short white hairs; vittae thus formed dull black and not shining as in *stylosa*. Scutellum grayish ochreous with three pairs of marginal bristles.

Legs black, basal two-thirds of hind tibiae and basal three-fourths of other tibiae reddish yellow.

Wings hyaline with a light flavescent tinge.

Abdomen with dorsum brown pollinose, segment 2, broad apices of following segments, sides, and venter gray. Short white setae are quite noticeable over tergum.

FEMALE.—Similar to the male, but with only light brown basal markings on the abdominal segments; pollen nearly worn off dorsum of 6; dorsum of 7 and all of 8 shining black.

TYPES.—Holotype, male, June 24, 1934, Kenton, Oklahoma (A. E. Pritchard). Allotype, female, same locality, June 21, 1934.

This species is named in honor of Mr. Joseph Wilcox from whom I have received much material used in these studies.

Ommatius parvulus Schaeffer

SCHAEFFER, 1916, Jour. New York Ent. Soc., XXIV, p. 69.

I took several females of this species in the Huachuca Mountains,

Arizona (type locality). In Curran's key to *Ommatius* (Amer. Mus. Novit., No. 327, 1928), *parvulus* will run to *tibialis* from which species it is immediately separable by the black femora.

***Ommatius bromleyi*, new species**

Black and yellowish in ground color, ochreous and brown pollinose; legs largely yellowish. Length, 11 to 12.5 mm.

FEMALE.—Head black, white pollinose, front and vertex with an ochreous tinge; bristles and hairs white, a pair of long bristles on mystax above and the ocellar bristles black; occipital cilia sometimes black. Antennae black, the basal segments yellowish or reddish; third segment one and one-half times as long as broad.

Thorax black in ground color, the calli, base of scutellum, pleurae broadly, and coxae reddish; covered with ochreous pollen; mesonotal vittae brown, somewhat rubbed off. Usual four bristles on sides of posterior half of mesonotum black; dorsocentrals present only as several small posterior setae; mesonotal hairs lacking. Scutellum sparsely covered with small fine hairs; scutellars absent.

Legs yellowish; dorsal apex of middle femora, apical two-fifths of hind femora especially dorsally, apex of hind tibiae, and tarsi except most of basal segment, dark brown. Middle femora with an anteroventral oblique row of 4 or 5 strong black bristles, and a row of weak white posteroventral bristles and hairs. Posterior femora with a row of 6–8 black anteroventral bristles, and a posterior row of 5 similar bristles, a long white bristle present between the two basal bristles of the latter row.

Wings hyaline, the apex grayish.

Abdomen black with most of segment 1, venter, dorsal spots, and segment 8 reddish; thinly grayish pollinose, a large spot on each segment covering most of its dorsum, brown pollinose. Hair short, yellowish, brown on dorsum of subapical two or three segments. Segment 8 and genital valves shining reddish. Abdomen not at all spatulate, only very slightly narrowed near base.

Types.—Holotype, female, San Carlos, Arizona, August 19, 1934 (A. E. Pritchard). Paratype, female, same data. Taken in the shade of trees along a spring-fed stream in an Arizona desert.

This species is named in honor of Mr. S. W. Bromley, who has been of much assistance in my work on Asilidae.

O. bromleyi is related to *spatulatus* Curran (Brazil) but is readily distinguished by the nearly yellow legs and non-spatulate abdomen of the female. A weak pteropleural bristle is apparent on one side of one of the specimens and, if considered as having such, will run to couplet 14 of Curran's key where it disagrees with both alternatives by having the tarsi yellowish basally and otherwise dark brown.

MALLOPHORINA CURRAN

Two Arizona species that I have of this genus are closely related to *guildiana* Williston, but certainly distinct from that species. The condition of the first posterior cell being open or closed affords an easy

means for the separation of these and the allied species, *acra* Curran, and a unique new species from New Mexico. *M. guildiana* may rarely be an exception to this, since Williston describes it as having this cell closed or nearly so.

In Oklahoma, *acra* occurs commonly over the state except the western part of the panhandle; *guildiana* is found only at the extreme end of the panhandle. On this basis, I would not expect the true *guildiana* to be found in North Carolina as Williston's description indicates.

TABLE OF SPECIES

- 1.—Femora black basally.....2.
Femora broadly reddish basally.....3.
- 2.—Posterior tibiae black-haired dorsally on whole length. *laphroides* Wiedemann.
Posterior tibiae yellow-haired on basal half.....*clausicella* Macquart.
- 3.—First posterior cell closed and petiolate.....4.
First posterior cell wide open.....6.
- 4.—Posterior femora with long black hairs below.....*acra* Curran.
Posterior femora with pile wholly yellow.....5.
- 5.—Tarsi black; middle tarsi of female black-haired.....*prudens*, n. sp.
Tarsi reddish yellow; middle tarsi of female yellow-haired. *guildiana* Williston.
- 6.—Mesonotal bristles mostly black; male genitalia reddish yellow, yellow-haired.....*frustra*, n. sp.
Mesonotal bristles and hairs whitish; male genitalia black, densely silvery haired above.....*pulchra*, n. sp.

Mallophorina prudens, new species

Smaller than *guildiana*, lighter and less pilose; tibiae of male and tarsi of female much more extensively black-haired. The wings are considerably lighter than in that species. Length, 8 to 11 mm.

MALE.—Head cinereous pollinose, thinner on front and vertex; bristles and pile white, yellowish on vertex, sometimes partly black on front. Mystax rather dense, the lower oral corners with black hairs; palpi with black and white hairs. Antennae black, basal segments and style reddish brown; style slightly shorter than third segment.

Thorax cinereous pollinose with an ochreous tinge; mesonotum with a darker geminate median stripe and a short, divided median stripe on each side. Pile whitish, yellowish and short on the mesonotum where the bristles and sometimes the hairs on the posterior half are in part black.

Legs reddish yellow; front femora usually with a dorsal black stripe on apical half; middle femora black above except at base; hind femora black on apical two-thirds; apex of hind tibiae and all the tarsi black. Pale hairs for the most part white; black hairs on venter and dorsal half of front tibiae, venter, and most of dorsum of middle tibiae, apical half and sometimes venter of hind tibiae.

Wings nearly hyaline, lightly washed with brown. First posterior cell long petiolate apically.

Abdomen black, gray pollinose on narrow posterior margins of the segments,

broadly on sides and venter; black of dorsum sharply differentiated. Pile white on first segment and apex, otherwise dull yellow.

FEMALE.—Similar, mystax and palpal hairs all white; anterior four tibiae pale-haired or with a few black hairs at dorsal apex of middle pair, hind tibiae with apical third black-haired; front tarsi with hairs mostly pale.

TYPES.—Holotype, male, Oracle, Arizona, April 23, 1934 (A. E. Pritchard). Allotype female, Whiteriver, Arizona, August 18, 1934 (A. E. Pritchard). Paratypes: one male, two females, Oracle, and one male, Whiteriver, same data respectively.

Mallophorina frustra, new species

Differs from *guildiana* and *prudens* by having the first posterior cell open, the wings considerably darker, and the lower part of the mystax black in the male. Length 9.5 to 11.5 mm.

MALE.—Head gray pollinose, ochreous on vertex; pile and bristles white, yellow on vertex and black on front, lower part of mystax, and palpi. Hairs of mystax fine, not very thick. Antennae black, black-haired on basal two segments; style two-thirds to three-fourths as long as third segment.

Thorax cinereous brown pollinose, darker on dorsum; yellowish pilose. Mesonotum with bristles black and with black hairs posteriorly.

Femora reddish yellow, black above, the hind pair black except narrowly on base and venter; yellowish pilose, usually with long black hairs below on posterior femora. Tibiae yellowish, reddish yellow apically. Anterior tibiae when viewed from in front with long white hair externally, and shorter yellow hair on inner half, black on apical fourth or less; a few long black back hairs usually present in front and behind. Other tibiae yellow-haired; middle tibiae with black hairs at apex in front, and usually with a few black hairs along dorsum and venter; hind tibiae with apical third to two fifths black-haired, usually with ventral black hairs and several black dorsal bristles in the yellow of basal part. Tarsi reddish brown, black-haired.

Wings rather dark brown, especially along the costa. First posterior cell apically narrowed, but open.

Abdomen black on dorsum; narrow posterior border of each segment, broad sides, and venter cinereous brown pollinose. Pile yellow, paler on first segment. Genitalia reddish yellow.

FEMALE.—Similar, the pile generally paler; mystax, and usually palpal hairs pale; femora and tibiae with clothing nearly all pale; hairs of front tibiae not differentiated in male; black hairs of hind tibiae restricted to apical fourth; pale hairs on front, middle, and sometimes posterior tarsi.

TYPES.—Holotype, male, Tem (south of Whiteriver), Arizona, August 19, 1934 (A. E. Pritchard). Allotype, female, same data. Paratypes: two males, two females, August 18, Whiteriver, Arizona (A. E. Pritchard).

Mallophorina pulchra, new species

Distinguished from all other species in the genus by the dense appressed white hairs on the male genitalia. Length 10 to 11 mm.

MALE.—Head cinereous pollinose; hairs and bristles white or pale yellow, only the second antennae segment with black hairs. Mystax long and dense, extending to the antennae and completely concealing the face when viewed from in front. Antennae black; arista as long as third segment. Eyes green in life.

Thorax gray pollinose, dorsum darker; covered with white or pale yellow pile; mesonotal bristles white or pale yellowish.

Legs orange-yellow, the coxae, trochanters, apical third of middle femora, apical half of hind femora, broad apex of hind tibiae, and tarsi all black. Femora bright yellow pilose, outer apex of posterior pair black-haired; usual spinelike bristles on middle and hind femora black. Tibiae with long yellow pile, the posterior pair black-haired on apical half with a dorsal row of black bristles and a few black hairs. Anterior tarsi with yellowish hairs, tarsal clothing otherwise black.

Wings clear brown, somewhat darker along costa. First posterior cell widely open at margin, and but slightly narrowed.

Abdomen cinereous pollinose with a dorsal rounded, non-pollinose spot over basal two-thirds of each segment; posterior margin of each dull black fascia thus formed narrowly margined with brown pollen. A midventral stripe is similarly dull black. Pile whitish on first segment, otherwise yellow, especially bright on the sides. Genitalia black, bearing dense, appressed white pile above.

FEMALE.—Similar, the pile of the body and legs white; hind femora without black hairs at apex; hind tibiae with black hairs, or not, over the apical third. Ovipositor black, genital valves dark brown.

TYPES.—Holotype, male, August 29, 1934, Carlsbad, New Mexico (A. E. Pritchard). Allotype female, and four paratype males, same data.

Promachus oklahomensis, new species

Closely allied to *fitchii* Osten Sacken, but lighter, the body nearly grayish and wings nearly hyaline; gray shadow in the first submarginal cell distinctly narrower than the marginal cell. The male genitalia lacks the median projection near the upper inner edge of the outer forceps at the middle which is present in *fitchii*. Length, 21 to 29 mm.

MALE.—Head black, density yellowish-gray pollinose; clothed with light yellowish bristles and hairs; occipital cilia sometimes partly black. Antennae black, first segment in part reddish; style dark reddish, about as long as antennae. Palpi dark reddish brown, bristly. Eyes emerald green in life.

Thorax yellowish-gray pollinose, the mesonotum with a darker geminate median stripe wide in front, and a wide stripe on each side. Hairs and bristles whitish or pale yellowish, a few of the pronotal bristles rarely, short setae over the mesonotum, mesonotal bristles for the most part, and several of the scutellar bristles black.

Legs black, the femora behind, tibiae, and tarsi reddish; clothed with recumbent whitish hairs and black and whitish bristles.

Wings nearly hyaline, lightly washed with brown. Shadow in the first submarginal cell narrower than the marginal cell.

Abdomen gray pollinose with a middorsal row of dark spots, covered with whitish hairs; segment 8 with black hairs. Genitalia reddish, nearly black dorsally, as long as segments 5, 6, and 7 combined; pale-haired, with dense, silvery appressed hairs above, the dorsolateral corners black-haired on apical half.

FEMALE.—Similar, ovipositor black.

TYPES.—Holotype, male, Kenton, Oklahoma, June 26, 1933 (A. E. Pritchard). Allotype female, same data. Paratypes: 33 males, 26 females, same locality, June 22–29, 1933; one male, Granite, Okla., July 9, 1934 (A. E. Pritchard).

This species is a western equivalent to *fitchii*. It was found commonly in an open gully filled with cat-tails, flying with a high-pitched buzz, and preying voraciously. Prey included acridids, winged ants, a bombyliid, a small cicada, and a scarab.

Proctacanthella jamesi, new species

Easily recognized from other members of the genus by a middorsal row of contrasting dark spots on the abdomen. Male genitalia with a posteriorly directed fan of long bristles on either side of the ninth sternite. Length, 19 mm.

MALE.—Head black, densely white pollinose, the vertex broadly ochreous; hairs and bristles white, pale yellow on vertex. Mystax dense, with longer bristles below; front with a dense patch of hairs on either side. Antennae black, tip of basal segment and second segment reddish; third segment as long as first two together, style slightly shorter than third segment, hairs on basal segments mostly white.

Thorax black in ground color, the anterior calli and pleurae posteriorly reddish. Covered with yellowish-gray pollen with three brown stripes over the mesonotum, the middorsal stripe bisected, wide and contrasting. Vestiture white, a few of the mesonotal setae black.

Legs reddish, black above on anterior four femora, and in front on hind femora, also with a black anterior streak on middle tibiae; covered with recumbent white hairs; bristles white except the short ones on the venter of the tarsi which are brown or black. Claws black, reddish basally.

Wings hyaline, veins brown. Halteres yellowish red.

Abdomen reddish in ground color on the broad apices of the segments, venter and posterior segments; covered with light gray pollen, tinged with ochreous; a middorsal dark brown spot on each segment except 7 and 8. Clothing white, the setae on the brown spots brown. Genitalia reddish, thinly pollinose and white pilose; a fan of bristles on a tubercle on each side of the ninth sternite is posteriorly directed and curved upward; ninth sternite truncately produced at apex.

FEMALE.—Similar, the middorsal, abdominal spots narrower.

TYPES.—Holotype, male, Kenton, Oklahoma, June 22, 1933 (A. E. Pritchard). Allotype female and one paratype male, same data. Paratype, male, Trinidad, Colorado, June 7, 1932 (C. R. Jones), in the collection at Colorado Agricultural College, Fort Collins.

Named in honor of Mr. M. T. James, to whom I am grateful for assistance and encouragement in my work with this group.

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RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 6

TWENTY-FOUR APPARENTLY UNDESCRIBED BIRDS FROM NEW GUINEA AND THE D'ENTRECASTEAUX ARCHIPELAGO

BY ERNST MAYR AND A. L. RAND

The following new forms have been discovered in the course of working out the collection made by the 1933-1934 Expedition to Papua. This expedition was financed, organized, and led by Mr. Richard Archbold. Other collections which were studied at the same time and in which some of the new forms were found are: (1) A collection made by Mr. J. T. Zimmer in 1920 and 1921, in southeast New Guinea; (2) a collection made by Rollo H. Beck in 1928 and 1929, at Samarai and in the Huon Peninsula of New Guinea; and (3) the collection made by the Whitney South Sea Expedition (Hannibal Hamlin) in 1928 and 1929, in southeast New Guinea and the D'Entrecasteaux Archipelago.

One new species is described. Three of the twenty-four subspecies are from the D'Entrecasteaux Archipelago; two are from the Huon Peninsula; eleven from the lowlands of south New Guinea; and eight are from southeast New Guinea. Four of the new southeast New Guinea subspecies are altitudinal representatives of lowland forms. Three of the south New Guinea races belong to species that have hitherto not been recorded for New Guinea.

Synoicus ypsilophorus mafulu, new subspecies

TYPE.—No. 419320, American Museum of Natural History; ♂ ad; Mafulu, Central Division, Territory of Papua; October 19, 1933; Richard Archbold and A. L. Rand.

DIAGNOSIS.—This mid-mountain race is distinguished from the other New Guinea races by its size, which is intermediate between that of the alpine and the lowland forms. The male differs from the male of *plumbeus* in the much more heavily barred under parts and the more definitely patterned upper parts. On these, the gray areas are reduced, as are the rufous streaks, while the white shaft-streaks are wider and more numerous than in *plumbeus*.

The females differ from *plumbeus* in the darker, richer, olive-brown color, the increase of the size of the dark markings above, and in the increase of barring and the reduction of the vinaceous color of the under parts.

MEASUREMENTS.—Wing: ♂ ad. 90, 90, 91, 95, 95, 96, 97; ♀ ad. 89, 90, 91, 91.5,

93. (*plumbeus* has a wing, ♂ ad., 85–94.)

MATERIAL.—Mafulu: 3 ♂ ad., 4 ♀ ad.; October 19–November 4.

Bella Vista: 4 ♂ ad., 1 ♀ ad.; November 7–9.

DISTRIBUTION.—Probably restricted to the mid-mountain grasslands of south-east New Guinea from about 1000 to 2000 meters. Besides the above series, there are 5 adult males and 4 adult females in the Rothschild collection from Owgarra, Angabunga River, 6000–8000 feet, which obviously belong to this form.

REMARKS.—The sexual dimorphism in this subspecies is more pronounced than in the alpine form, but less so than in the lowland *plumbeus*. This new subspecies is more similar in size, pattern, and sexual dimorphism to *australis* of eastern Australia than it is to the lowland forms of New Guinea. It differs greatly from *australis* in the generally darker color and the absence of bright rufous tones.

Synoicus ypsilophorus monticola, new subspecies

TYPE.—No. 419334, American Museum of Natural History; ♂ ad.; Mt. Albert Edward, southwest slope, alt. 3680 meters, Territory of Papua; June 23, 1933; Richard Archbold and A. L. Rand.

DIAGNOSIS.—Differs from other New Guinea races in its larger size, and the reduction of the sexual dimorphism, the male being less different from the female.

From *mafulu* the male differs in being more coarsely marked and averaging more buffy brown below; above, it differs in being lighter, more brownish in general color, in having wider and more plentiful shaft stripes, in being more definitely and coarsely barred, and in lacking the gray streaks and black specklings on the feathers.

The female of *monticola* differs from that of *mafulu* in being brighter rufous above and below.

MEASUREMENTS.—Wing: ♂ ad. 104, 109, 109; ♀ ad. 102, 103.

MATERIAL.—Mt. Albert Edward, southwest slope: 3 ♂ ad., 1 ♀ ad.; June 20–23.

Murray Pass: 1 ♂ ad., 1 ♀ ad.; August 7.

DISTRIBUTION.—Known only from the Alpine zone on the Wharton Range, above 2800 meters.

REMARKS.—This form is most like *ypsilophorus* (Bosc) of Tasmania in both size and the reduction of the sexual dimorphism. It differs from it especially in the wider shaft-streaks, the more regular, uniform barring, the lack of gray streaks on the upper parts, and the more heavily barred under parts.

Though the mid-mountain form *mafulu* and the Alpine race *monticola* are altitudinal representatives of the lowland *plumbeus*, these mountain forms are more like some of the more southern representatives of the species, the effects of altitude on size, reduction of sexual dimorphism and pattern being equivalent to the effects of latitude.

Synoicus ypsilophorus dogwa, new subspecies

TYPE.—No. 421706, American Museum of Natural History; ♀ ad.; Dogwa, Oriomo River, Western Division, Territory of Papua; February 16, 1934; Richard Archbold and A. L. Rand.

DIAGNOSIS.—This race is closest to the two other lowland New Guinea races, *plumbeus* and *saturation*, with the sexual dimorphism still more pronounced. The females differ from those of *plumbeus* in the heavier and more extensive barring below, in lacking the vinaceous tinge of the under parts of some specimens, in having the buffy ochraceous of the breast more evenly distributed over the under parts, in having the general color of the upper parts darker and more olive-brown, and the black spots larger. The males differ from males of *plumbeus* in the much darker, more clear gray and less patterned upper parts. Five males are entirely clear gray on the under parts, the other two approach a patterned bird from southeast New Guinea.

The females differ from females of *saturation* in being much more buffy below, more evenly distributed over the under parts, instead of vinaceous restricted to the breast region, in being above generally darker, richer, olive-brown, not light grayish olive, in having larger black spots, and average wider shaft-streaks. Five of the males differ from the males of *saturation* in being much darker gray above and clear gray below without rufous streaks on the under parts; the other two are more similar to the *saturation* males.

MEASUREMENTS.—Wing: ♂ ad. 84, 85, 87, 88, 89, 91; ♀ ad. 82, 85, 86, 90, 91.

MATERIAL.—Dogwa: 6 ♂ ad., 4 ♀ ad.; February 15–25.

Wuroi: 1 ♂ ad., 1 ♀ ad.; January 20.

DISTRIBUTION.—Probably restricted to the lowlands of south New Guinea.

REMARKS.—For comparison we have 3 ♂ ad. and 7 ♀ ad. of *saturation*; 4 ♂ ad. and 7 ♀ ad. of *plumbeus*.

Psittacella modesta huonensis, new subspecies

TYPE.—No. 266939, American Museum of Natural History; ♀ ad.; Sevia, Huon Peninsula, New Guinea; March 25, 1929; R. H. Beck.

DIAGNOSIS.—This form differs from *madaraszi* in the female by lacking the red apical tips to the feathers of the nape and hind neck, and in the reduction of the black barring above. The male is very similar to that of *madaraszi*, but tends to have crown and nape more yellowish, less brownish.

MEASUREMENTS.—Wing: ♂ 93, ♀ 92.

MATERIAL.—Zakaheme, alt. 4000 feet: 1 ♂ ad.; February 28 (Beck).

Sevia, alt. 5000 feet: 1 ♀ ad.; March 25 (Beck).

DISTRIBUTION.—Known only from the mountains of the Huon Peninsula.

Ninox novaeseelandiae pusilla, new subspecies

TYPE.—No. 421868, American Museum of Natural History; ♂ ad.; Dogwa, Oriomo River, Territory of Papua; February 16, 1934; Richard Archbold and A. L. Rand.

DIAGNOSIS.—This race differs from *macgillivrayi* Mathews, from Cape York, in its smaller size, the more reddish brown color of the upper parts and the reduction of white in the upper parts of the wing and scapulars.

MEASUREMENTS.—Wing, 197, 200; tail, 103, —.

Two male specimens of *macgillivrayi* measure: wing, 219, 220; tail, 120, 125.

MATERIAL.—Dogwa: 2 ♂ ad.; February 16, 17.

DISTRIBUTION.—Known only from the two specimens from south New Guinea.

REMARKS.—This is the first record for this species from New Guinea. *N. assimilis* belongs to a different species, *connivens*.

Aegotheles cristatus major, new subspecies

TYPE.—No. 421872, American Museum of Natural History; ♀; Dogwa, Oriomo River, Territory of Papua; February 27, 1934; Richard Archbold and A. L. Rand.

DIAGNOSIS.—This new subspecies is distinguished from the north Queensland *olivei* by the narrower nuchal band, the darker, more blotched dark markings on the breast, and by its larger size (wing, 149, against 135, 136). The type is molting out of immature plumage and the adult bird may be even larger.

MEASUREMENTS.—Wing, 149; tail, 127.

MATERIAL.—The type is unique.

DISTRIBUTION.—Known only from Dogwa in south New Guinea.

REMARKS.—The discovery of this race in south New Guinea, where *bennetti* also occurs, makes it necessary to consider the New Guinea forms *bennetti*, *affinis*, and *wiedenfeldi* as belonging to a different species for which *affinis* Salvadori is the oldest name.

A. c. major differs from *A. a. bennetti* in its much larger size, the rufous ear-coverts, the less densely vermiculated back, the more distinct markings on the outer webs of the remiges, the broader light bars and narrower dark bars in the tail, and by having the dark markings of the under part more restricted to the upper breast, and less regular, more blotched in pattern.

Lyncornis archboldi, new species

TYPE.—No. 419729, American Museum of Natural History; ♂ ad.; Mt. Tafa, west slope, altitude 2400 meters, Territory of Papua; September 23, 1933; Richard Archbold and A. L. Rand.

DESCRIPTION.—This species is most closely related to *L. papuensis* but differs from it in the generally bolder, coarser pattern; the breast lacks the fine barring of *papuensis*, the upper parts lack vermiculations, and there tend to be pronounced clear gray areas on the feathers of the upper parts. The tail feathers have light-colored tips.

MALE.—The feathers below are dusky blackish on the throat and breast with pale buffy rufous subterminal bands, widest toward the center, where they are sometimes divided by a narrow dark streak along the shaft. This gives a spotted, rather than a uniform barred appearance. The feathers of the abdomen have a broad somewhat triangular subterminal spot and usually a second narrow band of pale rufous, thus the abdomen appears nearly all pale buffy rufous irregularly mixed with blackish. The under tail-coverts are the color of the abdomen, with several blackish

bars. On each side of the neck is a white band reaching up to behind the ears; the chin is blackish with faint buffy markings. The sides of the head are black, with a few fine irregular marks of buffy rufous. The feathers along the sides of the crown are gray with a few indistinct fleckings of black and a more or less pronounced black streak in the center. These streaks are wider toward the middle of the head, which is black, some of the feathers with incomplete gray edges. The feathers of the nape are black with more or less gray edges; those of the interscapular area black with a broad gray streak down one (sometimes both) edge of the feather and a single small rufous spot at the end of the gray streak. The scapulars are gray, with a large black blotch at the tip of the feather and several small rufous spots near the tip. The gray basal part of the feather may be more or less barred with black and one web may be heavily marbled with dusky; a dark central shaft-streak is usually present. The lesser wing-coverts are blackish, lightly tipped with rufous, the others, black with a pair of subterminal rufous spots nearly meeting at the feather shaft. The lower back and upper tail-coverts are dusky, variegated with gray, and usually with a pair of subterminal rufous spots, one on each corner of the end of the feathers, especially on the rump; the longest upper tail-coverts are more gray, marked with black.

The outer pairs of tail feathers are largely black with about eight incomplete rufous bars on both webs. The central pair of tail feathers is missing in the male but the next pair has the incomplete bars rufous on the inner web, and gray, marbled with blackish on the outer web. All have a narrow terminal band of buffy rufous.

The primaries are black, unmarked; the secondaries, black with more or less rufous markings on the inner web and incomplete rufous edgings near the ends of the feathers on both webs; the tertials are gray, marked with broken bars and flecks of black, and with or without spots of rufous along the edge. The under wing-coverts are black with only a few faint rufous markings.

The two females are similar but with more rufous markings in the cheeks, more pronounced in one than the other, more conspicuous gray streaks on the sides of the top of the head, more gray in the hind neck; the black feathers of the center of the head are more or less edged with pale rufous which is largely worn off in some feathers. The rufous spots on the back are somewhat larger and more conspicuous; there are more definite rufous markings in the secondaries; the outer tail feathers have more (about 11) incomplete rufous bars. The central tail feathers (lacking in the male) are gray and black, with about eight incomplete irregular gray bars heavily marked with black, and wider though irregular black bars. Color of soft parts of female: iris dark, bill brownish black, feet pinkish dusky, nails blackish.

Due to the condition of the tails of these birds the shape is not easily determined, but apparently it is double rounded, the first, or outer, being shorter than the fourth; in the one female with a nearly complete tail the central tail feathers are nearly the same length as the outer feathers, the intermediate feathers being the longest. The second primary is longest, the first subequal to the third. There are no elongated tufts of feathers on the head.

MEASUREMENTS.—Wing: ♂ 212; ♀ 209, 212. Tail: ♂ —; ♀ 145, 148.

MATERIAL.—Mt. Tafa, west slope: 1 ♂, 2 ♀; September 18, 23.

DISTRIBUTION.—Known only from the three specimens taken on Mt. Tafa at an altitude of 2400 meters.

REMARKS.—Many of the breast feathers have the tips worn off so that only a trace of white tip remains; the white color may be due to fading, though some of the feathers on the lower breast have nearly white spots.

Stresemann has examined Reichenow's *L. elegans* (1899, Orn. Monatsber., VII, p. 130—Ramu) and decided it is the young of *L. papuensis*; certainly from the description it cannot be *archboldi*. Ramsay's *Eurostopodus astrolabae* is probably *L. papuensis* as Salvadori has pointed out (1884, Ibis, p. 354). The description fits *papuensis* very much better than *archboldi*.

***Pomatorhinus temporalis strepitans*, new subspecies**

TYPE.—No. 421974, American Museum of Natural History; ♂ ad.; Dogwa, Oriomo River, Western Division, Territory of Papua; February 24, 1934; Richard Archbold and A. L. Rand.

DIAGNOSIS.—Similar to *cornwalli* Mathews from Cape York but differing in its darker coloration. The crown stripe and hind neck are darker gray, the back, rump, and wing-coverts more blackish; flanks, abdomen, and thighs much darker, less tinged with sandy. In *cornwalli* the upper back differs only slightly from the hind neck and crown stripe; in *strepitans* the dark upper back contrasts more sharply with the gray of the hind neck and crown stripe.

MEASUREMENTS.—Wing: ♂ ad. 118; ♀ ad. 110, 111, 113, 115, 115.

MATERIAL.—Dogwa: 3 ♂ ad., 2 ♀ ad.; February 23, 24.

Wuroi: 4 ♂ ad., 4 ♀ ad.; January 19–February 11.

DISTRIBUTION.—South New Guinea.

REMARKS.—Hartert compared three New Guinea specimens of *P. temporalis* with Cape York birds (Bangs and Peters, 1926, Bull. Mus. Comp. Zool., Cambridge, LXVII, p. 430) and found no significant differences. Comparing our larger series of New Guinea birds with the Cape York material that Hartert had, which includes the type of *cornwalli*, we come to the conclusion that these forms can be separated.

***Cinclosoma ajax alaris*, new subspecies**

TYPE.—No. 421959, American Museum of Natural History; ♀ ad.; Wuroi, Oriomo River, Western Division, Territory of Papua; January 24, 1934.

DIAGNOSIS.—Most closely resembles *goldiei* Ramsay of southeast New Guinea but differs in the female in being larger and much deeper rufous brown instead of olive-brown on the upper parts. The wing-coverts near the bend of the wing are brown, with subapical black and apical white marks, instead of largely black with fewer white spots.

MEASUREMENTS.—Wing, *goldiei*: ♂ ad. 103, 104; ♂ imm. 98, 98, 101; ♀ ad. 92.

MATERIAL.—*Goldiei*: 1 ♀ ad. Milne Bay, 3 ♂ immature Milne Bay, Orangerie Bay, and southeast New Guinea, and 2 ♂ ad. Milne Bay and China Straits. The type of *alaris* is unique.

DISTRIBUTION.—Probably south New Guinea.

REMARKS.—The race *ajax* from west New Guinea is quite different from both these forms, being larger, with very much darker brown upper parts, and black lores and postocular stripe (2 ♂ ad., 2 ♀ ad., Weyland Mountains, Stein coll.; wing: ♂ ad. 114, 114; ♀ ad. 109, 110. The type of *ajax*, a female, from Lobo Bay, has the lores and postocular stripe black (Temminck, 1835, 'Plan. Col.,' Pl. 573) as do the Weyland Mountain females.

Microeca leucophaea zimmeri, new subspecies

TYPE.—No. 295523, American Museum of Natural History; ♂ ad.; Port Moresby; July 11, 1920; J. T. Zimmer.

DIAGNOSIS.—The specimens from New Guinea appear to represent a resident race hitherto undescribed. It is similar to *pallida* but differs in having the upper parts tinged with greenish instead of ashy brown, the under parts tinged with yellowish instead of whitish, the upper parts distinctly darker, the sides of the breast darker gray, and in having the bill wider at the base.

MATERIAL.—Port Moresby: 2 ♂ ad., 2 ♀ ad.; June 20, July 11.

DISTRIBUTION.—Known only from the vicinity of Port Moresby.

REMARKS.—The June specimens are slightly worn, those from July show more wear.

These were taken in the savanna near Port Moresby.

Microeca leucops auricularis, new subspecies

TYPE.—No. 422051, American Museum of Natural History; ♂ ad.; Wuroi, Oriomo River, Territory of Papua; January 23, 1934; R. Archbold and A. L. Rand.

DIAGNOSIS.—Though we have but this single specimen from south New Guinea, it differs so markedly from the known races that it seems advisable to describe it. It is closest to *albifacies*, but differs in having a pure white throat (not whitish as in some specimens of *albifacies*) of about 10 mm. extent, sharply defined posteriorly and confluent with the white sides of the head, in having the ear-coverts white, tinged with blackish posteriorly and ventrally. There is also an extension of the white eye-ring backward as a short superciliary line; the crown is dark, more blackish gray, less olive, and the bill (in the dry skin) is yellow with only the tip of the maxilla black. The black of the forehead is separated from the base of the bill by a white forehead of about 3 mm. width.

MEASUREMENTS.—Wing: 79 mm.

DISTRIBUTION.—Probably restricted to south New Guinea.

REMARKS.—The specimen shows no wing molt, and was in breeding condition.

This was the only specimen seen at Wuroi. It was low in the ground cover of the forest, clinging to the sides of upright stems and scolding at me.

Phylloscopus trivirgatus hamlini, new subspecies

TYPE.—No. 224065, American Museum of Natural History; ♂ ad.; Goodenough Island, D'Entrecasteaux Archipelago; November 20, 1928; Hannibal Hamlin.

DIAGNOSIS.—Similar to *Phylloscopus trivirgatus giulianettii* Salvadori, but sides of the crown much darker, olivaceous black, not grayish green; under parts richer greenish yellow; green of back with a citrine tinge; edges of wing-feathers richer greenish; yellowish stripe across the middle of the crown more pronounced, blackish postocular stripe very conspicuous; chin whitish, but upper throat mixed with greenish yellow; superciliary stripe more yellow than whitish. Bill longer and stronger.

	WING	TAIL	CULMEN	TARSUS
1 male adult	58.0	40	13.5	21.5
1 female adult	53.5	37	13.5	21.0

DISTRIBUTION.—Goodenough Island.

REMARKS.—We name this striking new form in honor of Hannibal Hamlin whose explorations revealed for the first time the presence of a regular mountain avifauna on Goodenough Island.

Megalurus timoriensis alpinus, new subspecies

TYPE.—No. 420136, American Museum of Natural History; ♂ ad.; Mt. Albert Edward, southwest slope, altitude 3680 meters, Territory of Papua; July 2, 1933; Richard Archbold and A. L. Rand.

DIAGNOSIS.—This alpine race differs from *macrurus* in its average larger size [wing: ♂ ad. 70–76 (72.9) against 68–71.5 (69.3)], the breast, sides, and flanks being much grayer, lacking the buffy tinge of *macrurus*, the flanks having pronounced dark shaft-streaks, which are nearly lacking in *macrurus*, the upper parts having broader dark streaks extending farther down the back, and the rump being darker and more streaked.

MEASUREMENTS.—Wing: ♂ ad. 70, 70.5, 73, 74, 74, 76; ♀ ad. 67, 68, 69, 69, 69, 70, 70, 71.

MATERIAL.—Murray Pass: 3 ♂ ad., 4 ♀ ad.; July 19–August 8.

Mt. Albert Edward: 3 ♂ ad., 4 ♀ ad.; June 16–July 2.

DISTRIBUTION.—Known only from the Alpine zone on the Wharton Range, from 2800 to 3800 meters.

REMARKS.—Five adults of *macrurus* from the lowlands of southeast New Guinea (1 male Orangerie Bay, 2 males, 2 females Kumusi River) are quite different from the alpine birds. A large series from the mid-mountain grasslands, 1000 to 2000 meters, are somewhat different from either *macrurus* or *alpinus*, but are closest to *macrurus*. In size they fall within the limits of the lowland birds; the under parts are slightly darker but very similar to *macrurus*. On the upper parts the streaking tends to be coarser than in *macrurus* and to extend farther back, and the rump is slightly darker, and it differs from both the other forms in being more rufous. Though these mid-mountain birds differ somewhat

from both the lowland and the high altitude forms, they are much closer to *macrurus* of the lowlands with which they should be united, though there is a name, *punctatus* De Vis, available for them (1897, Ibis, p. 385).

Malurus alboscapulatus

The status of the different forms of *Malurus alboscapulatus* has long been imperfectly understood. With the present series of more than 200 specimens before us, it appears that with the recognition of several more races than have been admitted, the problem becomes clearer. Hartert had already come to the conclusion that explanations involving eclipse plumages and dimorphism were unnecessary (1930, Nov. Zool., XXXVI, p. 79) and we concur in this.

The adult males are always black, differing in the different races only in size. The female may be black, black with white under parts, or brownish and buffy with white under parts. These types are correlated with geographical distribution, and in connection with the size can be used in separating subspecies. The immature males resemble in general the females; the nestling plumages of both sexes are alike. The males, in some races at least, appear to have a dull black plumage between the juvenile and the fully adult plumage. Males in immature plumage, with skulls incompletely ossified, may breed. Immature birds usually have much longer tails than adults.

The following subspecies can be recognized.

M. a. alboscapulatus Meyer, Arfak Peninsula. The females are blackish above, with brown wings edged with grayish; under parts white with but little black along the sides of the body. The nestling plumage (1 ♀, Siwi) has a sooty black head, blackish brown back, brown wings without conspicuous light edges to the feathers; under parts all white with pale buffy flanks (4 ♂ ad., 1 ♂ imm., 3 ♀ ad., 2 ♀ imm.).

	MALE ADULT	MALE IMMATURE	FEMALE ADULT	FEMALE IMMATURE
Wing	50, 50, 51, 51	51	49, 49, 50	48, 48
Tail	40, 42, 40, 43	—	45, —, —	—, 46

M. a. aida Hartert, Weyland Mountains to Humboldt Bay. The females are all black, less glossy than the males, and with brown wings; the immature plumage is black with a little white in the chin (12 ♂, 7 ♀, Hollandia and Ifaar; 5 ♂, 4 ♀, vicinity of Weyland Mountains; 3 ♂, 5 ♀, Takar).

	MALE ADULT	FEMALE ADULT
Wing	48-51	45.5-49
Tail	36-40	39-42

M. a. tappenbecki Reichenow, from the Sepik region to Astrolabe Bay. Similar to *alboscapulatus* but smaller, blacker above, and with less light edgings to the wing

feathers (only two specimens). Wing: 48, ♂ ad.; 46, ♀ ad. Stresemann (1923, Arch. f. Natur., LXXXIX, Heft 8, p. 9) gives the following measurements for specimens obviously belonging to this form.

	MALE	FEMALE
Wing	(6) 44-48	(4) 46-47
Tail	(3) 34-36	46

M. a. moretoni De Vis, southeast New Guinea, on the north coast to Huon Peninsula, on the south coast to Port Moresby; similar to *aida* but smaller and the immature with more white on the under parts. One nestling from Huon Peninsula is all sooty black with only a white chin; three in nestling plumage from Samarai, Port Moresby, and Rona have white throats and the Samarai bird has a few white feathers in the abdomen; two Rona birds in immature plumage have considerable white in the abdomen as well as white throats. This increase in white on the under parts of the immature bird in the southwest part of the range may be an approach toward the next race. (Huon Peninsula, 2 ♂, 5 ♀; north coast of southeast New Guinea (Kumusi River, Baniara), 5 ♂, 5 ♀; Samarai, Milne Bay, 9 ♂, 7 ♀; Port Moresby, Rona, 11 ♂, 7 ♀.)

	MALE ADULT	FEMALE
Wing	44-48	45.0-48
Tail	36-43	41.5-47

M. a. naimii Salvadori and D'Albertis, known only from a small area in southeast New Guinea, from Galley Reach to the mainland opposite Yule Islands. Similar to *tappenbecki* but blacker above, more black on the sides of the body, and with longer tail. (11 ♂, 7 ♀, Baroka, Kubuna, Hisiu.)

	MALE ADULT	FEMALE ADULT
Wing	45-47	45-47
Tail	38-41	43-47

Malurus alboscapulatus mafulu, new subspecies

TYPE.—No. 420175, American Museum of Natural History; ♂ ad.; Mafulu, altitude 1250 meters, Central Division, Territory of Papua; October 16, 1933, Richard Archbold and A. L. Rand.

DIAGNOSIS.—Differs from *naimii* in its larger size (wing: ad. ♂ 48-51 against 45-47). This subspecies shows the same sexual and age differences as *naimii*, but the females and young of the new race average more black along the sides of the white under parts, more black on the breast, and show a reduction of white in the lores.

	MALE ADULT	MALE IMMATURE	FEMALE ADULT	FEMALE IMMATURE
Wing	48, 48, 48.5, 49, 49, 49, 49, 50, 50, 51	44, 47, 47, 47, 47, 49, 49.5	45, 46, 46, 47, 47, 48, 49, 49, 49, 49, 50.5	45, 45, 46, 46, 49
Tail	45, —, 45, 43, 43, 43, 49, 44, 44, 50	49, 56 (others molting)	—, —, 49, 44, 45, 48, 49, 48, —, —, 52	44, —, 49, 50, 54

MATERIAL.—Mafulu: 7 ♂ ad., 6 ♂ imm., 11 ♀, 3 ♀ imm., 2 ♀ fledglings; October 1–November 5.

Bella Vista: 1 ♂ ad., 1 ♂ imm., 2 ♂ fledglings, 1 ♀, 1 ♀ imm.; November 6–8.

Mt. Tafa, east slope: 1 ♂ ad.; May 17.

Ononge: 3 ♂ ad.; August 17, 19.

Ero Creek, 1600 meters: 1 sex (?) imm.; June 10.

DISTRIBUTION.—Probably restricted to the mid-mountain grasslands, between 1000 and 2000 meters, in southeast New Guinea.

REMARKS.—This is a mountain representative of *naimii*.

Malurus alboscapulatus dogwa, new subspecies

TYPE.—No. 422006, American Museum of Natural History; ♀ ad.; Wuroi, Oriomo River, Western Division, Territory of Papua; February 4, 1934; Richard Archbold and A. L. Rand.

DIAGNOSIS.—Distinguished from all the above races by the females and immatures having no black in the plumage. Closest to *lorentzi* but differs in its smaller size, particularly of the bill; the female and immature birds are much lighter, less blackish above, much browner on the back and rump, and much brighter buffy brown on the flanks.

	MALE ADULT	MALE IMMATURE	FEMALE
Wing	42, 42, 43, 43, 44, 44, 45, 45	41, 42, 42, 43, 44, 45	41, 41, 41, 41, 41, 41, 41, 41.5, 42, 42.5, 43
Tail	37, 39, 38, —, 38, 38, 38, 44	47, 47, 50, 52, 55	41, 43, 43, 44, 45, —, —, 44, 42, 45, 47

MATERIAL.—Wuroi: 5 ♂ ad., 2 ♂ imm., 7 ♀; January 18–February 11.

Dogwa: 3 ♂ ad., 4 ♂ imm., 4 ♀, 1 sex (?); February 17–26.

DISTRIBUTION.—South New Guinea, known only from the vicinity of the Oriomo River.

M. a lorentzi van Oort,¹ south New Guinea from the Noord River to the foot of the Snow Mountains (Setekwa and Oetakwa Rivers); closest to *dogwa* but differs in the female being darker above, more blackish on the head, duller on the flanks, and larger (Setekwa and Oetakwa Rivers, 3 ♂ ad., 4 ♂ imm., 2 ♀).

	MALE ADULT	MALE IMMATURE	FEMALE
Wing	47, 50, 51	47, 48, 48, 48	46, 50
Tail	42, 43, 44	50, 51, 51	48, 47

Paradisaea apoda salvadorii, new subspecies

TYPE.—No. 330366, American Museum of Natural History; ♂ ad.; Vanumai, Central Division, Territory of Papua; June 11, 1929; Hannibal Hamlin.

DIAGNOSIS.—Closely related to *raggiana* but the male is distinguished by the completely brown back, lacking the yellow tips to the feathers of the upper back, and by the more bronzy green, less blue-green gloss of the throat patch. The single fe-

¹ Type series in the Leiden Museum examined by Mayr.

male for comparison differs from a female of *raggiana*, taken at Annie Inlet, in lacking the yellow on the upper back and in having much less yellow, which is also duller, on the back of the head and neck, the black of the forehead extending farther back. *P. a. raggiana* is intermediate between *salvadorii* and *intermedia* De Vis.

MEASUREMENTS.—Wing: ♂ ad. 180, 183, 186, 187, 193; ♂ imm. 182, 184, 189.

MATERIAL.—Wuroi: 2 ♂ ad., 1 ♂ imm., 1 ♀; January 8–February 4.

Vanumai: 2 ♂ ad.; June 11, 13 (Hamlin).

Deva Deva: 1 ♂ ad.; May 25 (Hamlin).

Veimaui: 1 ♂ imm.; August 17 (Zimmer).

Cloudy Bay: 1 ♂ imm.; January 6 (Zimmer).

DISTRIBUTION.—South coast of southeast New Guinea from Wuroi, west of the Fly River to Cloudy Bay, inland to 1250 meters (seen commonly at Mafulu).

REMARKS.—The name *raggiana* has been used for the form of *apoda* occupying the area between the Fly River and Milne Bay. From a study of our material, however, it appears that this is not a uniform population and can be divided into two races. The males from Milne Bay and Orangerie Bay (7 specimens) are similar to each other and differ from the rest of the population in the characters given above. The specimens from Orangerie Bay have somewhat less yellow on the upper back than Milne Bay birds but are closest to them.

The type specimen is a trade skin lacking the back, but since other specimens from the type locality, Orangerie Bay, have the characters of the Milne Bay population, the name *raggiana* must be restricted to the population in the area between Milne Bay and Orangerie Bay, leaving the form from the rest of the south coast of southeast New Guinea without a name.

Myzomela rosenbergi longirostris, new subspecies

TYPE.—No. 224215, American Museum of Natural History; ♂ ad.; Good-enough Island, D'Entrecasteaux Archipelago; November 23, 1928; Hannibal Hamlin.

DIAGNOSIS.—This very distinct form is characterized by its much larger bill, averaging about five millimeters longer than in the New Guinea form; this character is just as distinct in the immature as in the single adult bird, in the present material. The wing and tail are also somewhat larger.

The first year plumage of the male differs from that of *rosenbergi* in being more grayish, less warm brown below, and in being more uniform olive-brown above, less blackish, spotted with warm brown on the back. The adult males are similarly colored.

	MALE ADULT	MALE IMMATURE	FEMALE IMMATURE
Wing	69	62, 62, 63, 63.5	57
Tail	46	42, 43, 41, 42	38
Bill	24	24, 25, 24, 24	22

MATERIAL.—Goodenough Island: 1 ♂ ad., 4 ♂ imm., 1 ♀ imm.; November 22, 23 (Hamlin).

DISTRIBUTION.—Goodenough Island, D'Entrecasteaux Archipelago.

Toxorhamphus iliolophus flavus, new subspecies

TYPE.—No. 422311, American Museum of Natural History; ♂ ad.; Wuroi, Oriomo River, Western Division, Territory of Papua; February 7, 1934; Richard Archbold and A. L. Rand.

DIAGNOSIS.—Similar to *Toxorhamphus iliolophus iliolophus*, but under parts and flanks conspicuously yellower.

WING MEASUREMENTS

	South New Guinea (Wuroi)	Southeast New Guinea
Male	64, 64, 66, 67	66, 68, 68, 68, 70
Female	58, 61	62, 63, 64, 64

MATERIAL.—Wuroi: 4 ♂, 2 ♀; January 25–February 7.

Kubuna: 1 ♀; December 1.

Mafulu: 5 ♂, 3 ♀, 1 sex (?); October 1–November 13.

DISTRIBUTION.—South and southeast New Guinea; from sea level to 1250 meters.

REMARKS.—The birds from southeast New Guinea are not exactly the same as the south New Guinea specimens, being slightly larger and somewhat darker green on the back, but they agree with them in the richer colored under parts and are preferably grouped with them.

Hartert (1930, Nov. Zool., XXXVI, p. 44) has already suggested that this species was divisible into three races, but he lacked adequate material on which to separate them. Mayr (1931, Mitt. Zool. Mus. Berlin, XVII, p. 656) has given additional notes on the geographical variation in this species. From the survey of the present material (4 Arfak Birds, 3 Cyclop birds (Mayr coll.), 2 Madang birds, and 6 from the Huon Peninsula (Beck coll.), in addition to the above listed material) there appear to be even more "populations" distinguishable by color differences. However, these populations may be grouped into three subspecies, and the following is perhaps the most satisfactory arrangement.

1.—*T. i. affinis* (Salvadori), from the Arfak, distinguished by its dark gray, not greenish crown, dull grayish green back, grayish under parts, and pale flanks.

2.—*T. i. iliolophus* (Salvadori), from Miosnom, Jobi, Cyclop Mountains, (Snow Mountains?), Sepik Mountains, and the Huon Peninsula, characterized by its greenish crown and back, and by its slightly yellowish under parts and flanks. The birds from the Cyclop, which Mayr compared and found identical with Miosnom and Jobi birds, have the upper parts much greener than the grayish green birds from the Huon Peninsula. Madang birds are somewhat intermediate. This does not agree with

the observations of Stresemann and Paludan (1932, Nov. Zool., XXXVIII, p. 221), who state that Jobi birds are identical with Huon Peninsula (Junzaing) specimens.

3.—*T. i. flavus* Mayr and Rand, from south and from southeast New Guinea. These two populations are not identical, but both are distinguishable from the others by the more richly colored under parts, especially the flanks. The south New Guinea birds have the greenish upper parts very similar to *iliolophus* from the Cyclop, much greener than those from the Huon Peninsula; southeast New Guinea birds with their darker grayish green backs are little greener than *iliolophus* from the Huon Peninsula.

There are two other races of *iliolophus*:

4.—*T. i. cinerascens* Stresemann and Paludan (1932, Nov. Zool., XXXVIII, p. 144) from Waigeu; the palest race, distinguished from 1 by the whitish, less grayish under parts, and the purer ash-gray, less olive-colored edges to the crown feathers.

5.—*T. i. fergussonis* (Hartert), from the D'Entrecasteaux Archipelago (Good-enough, Fergusson, and Normanby Islands, 6 specimens, Hamlin coll.), which approaches *flava* from southeast New Guinea but is easily distinguished from all the other races by its much longer bill and its longer wing. Wing: ♂ 72, 75; ♀ 65, 66, 67, 72.

Toxorhamphus poliopterus septentrionalis, new subspecies

TYPE.—No. 267876, American Museum of Natural History; ♂ ad.; Huambon [= Hompua], altitude 3000 feet, Saruwaged Mountains, Huon Peninsula, New Guinea; February 12, 1929; R. H. Beck.

DIAGNOSIS.—Mayr (1931, Mitt. Zool. Mus. Berlin, XVII, p. 657) has already pointed out that Huon Peninsula birds differ from those from southeast New Guinea in having a shorter bill and a less pure gray, more greenish crown. The present material supports these findings. In addition the Huon Peninsula birds have a slightly longer wing, though the bill is shorter.

	MALE ADULT	FEMALE ADULT	FEMALE IMMATURE
Wing	71	63.0, 64.0	63.0
Bill	30	27.5, 27.5	27.5

Mayr's measurements (*loc. cit.*)
of his Huon Peninsula material¹

Wing	69, 71, 72	62, 62, 63
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Stresemann (1923, Arch. f. Natur., LXXXIX, Heft 7, p. 53) gives the wing of a female from Schraderberg as 65.

A comparison of the wing-bill² indices of the southeast New Guinea and Beck's Huon Peninsula material helps to bring out the difference between these two forms.

¹ We found that the measurement of the culmen, measured from the base, brought out the difference in the size of the bills better than the method used in 1931, so, in the present comparison, we are unable to use the measurements recorded then.

² Wing-bill index = $\frac{\text{bill} \times 100}{\text{wing}}$.

	Southeast New Guinea	Huon Peninsula
Adult Male	48.6, 49.3	42.3
Adult Female	45.2, 45.9, 47.5	42.9, 43.7
MATERIAL.—Hompua: 1 ♂ ad., 1 ♀ imm.; April 9, Feb. 12 (Beck).		
Zakaheme: 1 ♀ ad.; April 8 (Beck).		
Sevia: 1 ♀ ad.; March 18 (Beck).		
DISTRIBUTION.—Huon Peninsula to the Sepik Mountains (Schraderberg).		

***Xanthotis polygramma candidior*, new subspecies**

TYPE.—No. 422322, American Museum of Natural History; ♀ ad.; Wuroi, Oriomo River, Western Division, Territory of Papua; February 7, 1934; Richard Archbold and A. L. Rand.

DIAGNOSIS.—This form is closest to *lophotis* but differs in having the black spots in the centers of the back feathers less distinct, and in the finer streakings and smaller triangular spots of the under parts, giving the under parts a whiter appearance (whence the name "*candidior*").

MEASUREMENTS.—Wing: 69, 71.

MATERIAL.—Wuroi: 2 ♀ ad.; January 27, February 7.

DISTRIBUTION.—South New Guinea.

REMARKS.—One specimen is molting its wing, the other is not; neither showed any enlargement of the ovary.

***Meliphaga virescens intermedia*, new subspecies**

TYPE.—No. 330252, American Museum of Natural History; Samarai Island, Papua; adult ♂; July 5, 1929; Hannibal Hamlin.

DIAGNOSIS.—This form is intermediate in color between the richly colored *versicolor* of south New Guinea and the pale *sonoroides* of north New Guinea. It differs from *versicolor* in the paler yellow under parts, the paler inner edging of the remiges, and the much more grayish upper parts. It differs from *sonoroides* in the yellower under parts and the darker, more greenish, less grayish upper parts.

MEASUREMENTS.—Wing: ♂ ad. 106, 107, 107; ♂ imm. 92, 99, 104; ♀ ad. 98, 104; ♀ imm. 92.

MATERIAL.—Samarai Island: 2 ♂ ad., 1 ♂ imm., 2 ♀ ad.; July 5 (Hamlin).

Doini Island: 1 ♂ ad., 2 ♂ imm., 1 ♀ imm.; November 16–December 2 (Zimmer).

DISTRIBUTION.—Probably restricted to extreme southeast New Guinea and the nearby islands. We have typical *sonoroides* from the Huon Gulf and Fergusson Island.

***Philemon citreogularis papuensis*, new subspecies**

TYPE.—No. 422372, American Museum of Natural History; ♀ ad.; Dogwa, Oriomo River, Territory of Papua; February 25, 1934; Richard Archbold and A. L. Rand.

DIAGNOSIS.—This is distinguished from *johnstoni* of north Queensland by its smaller size (females 118 and 120, against 128–130) and its generally darker color

above and below. The white spots on the dark breast stand out in contrast much more than in *johnstoni*.

MEASUREMENTS.—Wing: ♂ ad. 124, 124, 127; ♀ ad. 118, 120; bill: 31.5, 34, 31; ♀ 30, 31.5. Four females from north Queensland measure: wing, 128, 129, 130, 130; bill, 30, 30, 30.5, 32.

MATERIAL.—Dogwa: 3 ♂ ad., 2 ♀ ad.; February 19–28.

DISTRIBUTION.—Probably occurs only in south New Guinea.

REMARKS.—Though members of this genus fade very badly, the present New Guinea series is not in fresh plumage, and, compared with somewhat worn specimens of *johnstoni*, the difference in color is so marked that it seems it will prove constant. Some of the Australian specimens of this species, as well as some of the New Guinea birds, have yellow in the chin and throat. The significance of this is not clear; it appears not to be correlated with age or sex.

All but one of the present series are molting.

This is the first record of this species for New Guinea.

Zosterops fuscicapilla crookshanki, new subspecies

TYPE.—No. 222112, American Museum of Natural History; ♂ ad.; Goodenough Island, D'Entrecasteaux Archipelago; November 20, 1928; Hannibal Hamlin.

DIAGNOSIS.—Very different from *fuscicapilla* Salvadori, forehead and crown being olive as the back, not blackish; small dusky spot on the lores present, upper cheeks also partly dusky; white eye-ring very wide, but not quite closed on the anterior margin; rump not lighter and more yellow than the back, upper tail-coverts with a brownish wash; inner edges of wing-feathers (on the underside of the wing) not pure white but with a buffy tinge; on the under parts very similar to *fuscicapilla*, but less yellowish; flanks and under tail-coverts more strongly washed with olivaceous; tail less blackish, outer edges of tail-feathers olivaceous; olivaceous edges on primary-coverts and upper wing-coverts broader; larger.

MEASUREMENTS.—Two female adults: wing, 60.5, 60.5; tail, 41, 43.5; culmen, 15, 15; tarsus, 17, 17.5.

DISTRIBUTION.—Goodenough Island, D'Entrecasteaux Archipelago.

REMARKS.—We name this new race in honor of Lt. Commander Robert Crookshank, captain of the "France," who did so much to make the expedition a success.

Zosterops novaeguineae wuroi, new subspecies

TYPE.—No. 422406, American Museum of Natural History; ♂ ad.; Wuroi, Oriomo River, Western Division, Territory of Papua; February 7, 1934; Richard Archbold and A. L. Rand.

DIAGNOSIS.—This new form differs from the other three races of *novaeguineae* in having the throat and under tail-coverts more golden yellow, in having the upper

parts brighter more citrine green, and in having a wider white eye-ring. There is also slightly less black below the eye and the flanks are rather clear gray.

MEASUREMENTS.—Wing, ♂ ad. (type) 55; ♂ imm. 54; ♀ (?) imm. 53.

MATERIAL.—Three specimens from Wuroi, January 25, February 7.

DISTRIBUTION.—Probably the lowland country of south New Guinea. These are the first specimens of the species to be collected in this area. The other races are mountain birds.

REMARKS.—The adult male was not breeding. All three specimens are molting.

Thus we have in New Guinea four races:

1.—*Zosterops novaeguineae novaeguineae* Salvadori; Aru Islands and Arfak; wing, 53, 55, 55 (three Arfak specimens). Hartert (1930, Nov. Zool., XXXVI, p. 53) suggests that the Aru bird may be darker than the Arfak ones.

2.—*Zosterops n. oreophila* Mayr; Huon Peninsula; characterized by the darker upper parts and wider eye-ring, less gray on the sides of chest and flanks, a more extensive yellow throat, and larger size; wing, 60, 63, 64, 63, 64.

3.—*Zosterops n. crissalis* Sharpe; southeast New Guinea; distinguished from 2 by the lighter green of the upper parts, the slightly richer yellow of the throat and under tail-coverts, larger eye-ring, and more dusky flanks. It is also slightly smaller. This form is distinguished from 1 by larger size, slightly lighter green of the upper parts and richer yellow of throat and under tail-coverts, more dusky brownish flanks and larger eye-ring. The yellow of the throat is also slightly more extensive.

4.—*Zosterops n. wuroi*, new subspecies; lowlands of south New Guinea.

The brownish gray flanks of *Z. novaeguineae*, most pronounced in *crissalis*, also pronounced but clearer gray in *wuroi*, and less pronounced in the other two races, indicate a slight approach toward the *lateralis* group; but *lateralis* tends to have a gray back; *japonica* also has the same brownish flanks.

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VARIATION IN PACIFIC *TRACHUROPS* *CRUMENOPHTHALMUS*

By J. T. NICHOLS

Though little variable around the world, here and there one finds aberrant individuals or incipient races of *Trachurops* [Selar] *crumenophthalmus* (Bloch), which, while below the level of taxonomic recognition, show variations in body and fin form so considerable that they would characterize distinct species in genera allied to *Trachurops*, and are presumably associated with appreciable differences in habit. To what extent these differences in this and similar cases are phylogenetic and to what extent ontogenetic is an as yet unsolved problem in itself.

We may suppose that this is an old standardized species which for some reason bends without breaking, or, what seems more probable, that it is new and has only recently attained its abundance and wide distribution, as a corollary to which there is a tendency for certain individuals or groups to bud in this or that direction without sufficient time-element for the buds to become isolated or distinct.

A study of 5 full-grown specimens of similar size from different points in the eastern Pacific will illustrate the nature of variations referred to in this species. One is from the Gulf of California, collected in 1900 by L. Digue and presented by the Duc du Loubat, another from Carmen Island (also in the Gulf of California), collected by C. H. Townsend in 1911, a third from the Panama market, collected by William Beebe in 1925; the others were collected in 1934 from the Tuamotus by Templeton Crocker, and in 1935 from the Honolulu market by William J. Morden.

GULF OF CALIFORNIA FORM.—No. 236, Amer Mus. Nat. Hist., 185 mm. standard length. Depth in this length (greatest at origin of first dorsal), 3.6; head, 3.2. Eye in head, 3.2; pectoral, 1.1; caudal lobe broken. Width in depth at origin first dorsal, 1.8; at origin soft anal, 1.8. Dorsal soft rays, 24; anal, 22. Scutes, 25; straight part of lateral line in chord of its curve, 1.1. An appreciable ridge in middle of top of head.

Though from a locality which can not have been far from Carmen

Island, this form is more suggestive of that from Honolulu, in its thick cylindrical body, but is shorter-bodied with depth approximately that of our Panama specimen. Its greatest depth is at the first dorsal origin, and it shows the ridge on top of the head.

A small specimen with the same data is so much like it that this presumably is not an individual variant but represents a considerable body of fish, not sufficiently divergent for taxonomic recognition.

CARMEN ISLAND FORM.—No. 5502, Amer. Mus. Nat. Hist., 180 mm. standard length. Depth in this length (greatest at origin of second dorsal), 3.3; head, 3.3. Eye in head, 3.5; pectoral, 1.2; caudal lobe, 1.2. Width in depth at origin first dorsal, 2; at origin soft anal, 2.45. Dorsal soft rays, 27; anal, 22. Scutes, 32; straight part of lateral line in chord of its curve, 1.3. No ridge on top of head.

This form is deep behind, thick-bodied and pointed forward, with a long caudal and smooth lines, slight departures from normal which yet give it an unfamiliar appearance for *Trachurops* and suggest more Caranx-like habit and behavior. It has the ridge on top of head suppressed.

A second individual of about the same size with the same data is similar, and this presumably represents a small local group of fish differing somewhat in habits from the species in general, with characters too slight and indefinite for taxonomic recognition.

PANAMA FORM.—No. 7546, Amer. Mus. Nat. Hist., 175 mm. standard length. Depth in this length (greatest at origin second dorsal), 3.5; head, 3.2. Eye in head, 3; pectoral, 1.1; caudal lobe, 1.3. Width in depth at origin first dorsal, 2.2; at origin soft anal, 2.5. Dorsal soft rays, 26; anal, 22. Scutes, 30, straight part lateral line in chord of its curve, 1.3. A ridge in middle of top of head.

This form is close to the standard of the species as a whole, and to a figure of a somewhat smaller (approx. 145 mm.) Atlantic individual from Woods Hole (Jordan and Evermann, 1900, Bull. U. S. Nat. Mus., XLVII, fig. 385). It is perhaps more compressed than the Atlantic fish of equal size.

HAO ISL., TUAMOTUS FORM.—No. 12,661, Amer. Mus. Nat. Hist., 171 mm. standard length. Depth in this length (greatest at origin first dorsal), 4; head, 3. Eye in head, 2.7; pectoral, 1.3; caudal lobe, 1.8. Width in depth at origin first dorsal, 1.8; at origin soft anal, 1.85. Dorsal soft rays, 27; anal, 22. Scutes, 29; straight part of lateral line in chord of its curve, 1.4. A ridge in middle of top of head.

This form, with large head and eye and short caudal, more like that of *Decapterus* than *Trachurops* in character, is most aberrant. It has

the ridge on top of head, maximum depth at origin of first dorsal, and rather cylindrical body. Its peculiarities are quite sufficient to entitle it to taxonomic recognition. Though represented by but a single specimen, with a chance of this merely being an abnormal emaciated individual, the manner of its capture suggests correlation of its characters with peculiar nocturnal habits, hence I describe it as a new subspecies.

Trachurops crumenophthalmus crockeri, new subspecies

DESCRIPTION OF TYPE.—No. 12,661, Amer. Mus. Nat. Hist. Collected October 27, 1934, at Boring Bay, inside the lagoon of Hao Island, Tuamotus, by Templeton Crocker; attracted by submerged light and netted at night.

Length to base of caudal, 171 mm. Other measurements as above. Gill-rakers on lower limb of arch, about 28. Shoulder process high, and broad across its obliquely truncate end.

Color in preservative blue-black above, brownish on the sides, somewhat silvery below. J. P. Chapin gives me the following from his notes of October 27 concerning this specimen: "Mr. Crocker showed me a small fish not a mackerel but looking a little like it which gave back an orange-red glow from the eye in the yacht's electric light."

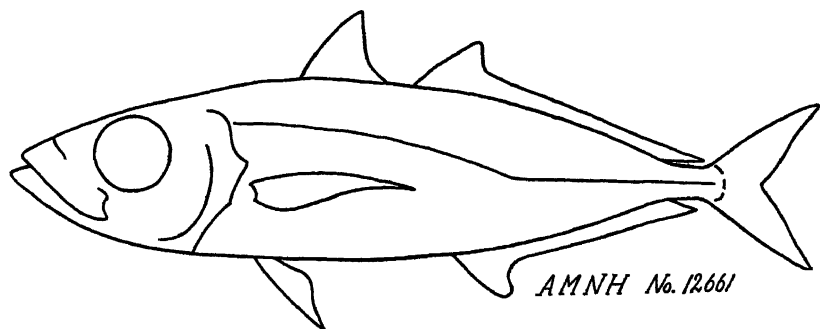


Fig. 1. *Trachurops crumenophthalmus crockeri*, type.

The dark color, large eye, small body and unusual caudal of this form are probably correlated with peculiar, perhaps nocturnal, habits.

HONOLULU FORM.—No. 12,680, Amer. Mus. Nat. Hist., 200 mm. standard length. Depth in this length (greatest from first to second dorsal origins), 4; head, 3.5. Eye in head, 3.2; pectoral, 1.3; caudal lobe, 1.35. Width in depth at origin first dorsal, 1.7; at origin soft anal, 1.7. Dorsal soft rays, 24; anal, 22. Scutes, 32; straight part lateral line in chord of its curve, 1.5. No ridge on top of head.

This is a decidedly long-bodied and cylindrical form with maximum depth extending between origins of first and second dorsals, and it also has the ridge on top of head suppressed at this size.

Seven other specimens collected at different times from the Hawaiian Islands and of different sizes (138 to 230 mm.), to hand for comparison, show only minor variations and differences correlated with size. It is safe to assume that this is at least the dominant form in that locality. All are slender (depth 4 to 4.3, except in the largest, 3.9). The body is relatively wide and ridge on top of head suppressed with greater size, subject to individual variation. The 230 mm. specimen has width in depth at origin first dorsal, 1.5; at origin soft anal, 1.6. Two of 144 to 145 mm. have the ridge slight to suppressed, whereas it is present in one of 156 mm. taken at another time, which is also compressed for this form, width in depth at origin first dorsal, 2; at origin soft anal, 2.3; and has the smallest eye of the series, 3.7. The 230 mm. specimen has the largest eye, 3.1, individual variation seemingly obliterating size variation in that character, as also in the number of scutes, more of which are usually developed in larger specimens, but only 26 in that of 230 mm. The arch of the lateral line is so low and meets the straight part at so slight an angle that proportional measurements between the two are not dependable or significant. The greater relative length of the pectoral in larger fish, which is characteristic of almost all carangin species, is here not very notable, but consistent; one of the smallest has this fin in head, 1.5, the largest has it 1.2, this fin being notably shorter than in specimens examined of the Manila form described beyond. Our 8 Hawaiian specimens represent 4 collections from this one general locality and give the impression that specimens of about the same size with the same data, presumably representing the same school or lot of fish, are more alike than specimens with other data, and that each big school of fish may show slight characters peculiar to itself.

Wakiya, 1924 (Ann. Carn. Mus., XV), lists and figures three species of this genus from Japanese seas, which have been tentatively synonymized with *Trachurops crumenophthalmus*, namely: *Selar mauritanus*, 177 mm. standard length, Kii (Pl. xviii, fig. 2); *Selar torvus*, 218 mm. standard length, Bonin Isls. (Pl. xix, fig. 1); *Selar macrophthalmus*, 175 mm. standard length, Bonin Isls. (Pl. xviii, fig. 3). The first is essentially undifferentiable from standard *crumenophthalmus*, the second seems to be identical with our Honolulu form, and the third is notably deep, compressed and large-eyed. Hence we may deduce that the Honolulu form has a very wide distribution across the North Pacific

in the general latitude of the Tropic of Cancer, and appropriately recognize it taxonomically, as an incipient species or as a subspecies. It presumably stands for a very large body of fish, the distinctive characters of which are in part phylogenetic, and in part ontogenetic and correlated with habits; and, whereas it is presumably dominant over its range, there is no reason to suppose that it completely replaces other forms there, as a true geographic race of birds or land mammals is supposed to do.

MANILA FORM.—The American Museum collections contain 4 small specimens from Manila, which represent an aberrant, deep, compressed form, with notably large head and eye, and seem to be identical with Wakiya's *Selar macrophthalmus*. If so, they presumably represent a considerable body of fish occupying this western corner of the Pacific, and may appropriately be recognized taxonomically as a subspecies.

They are No. 3920, Amer. Mus. Nat. Hist., 126 to 132 mm. standard length. Depth in this length, 3.4 to 3.6; head, 3 to 3.3. Eye in head, 2.7 (all four); pectoral, 1 to 1.2; caudal lobe (broken), est. 1.3 to 1.4 (2 specimens). Width in depth at origin first dorsal, 2.1 to 2.2 (and 2.7 once); at origin soft anal, 2.6 to 2.8. Dorsal soft rays, 25; anal, 21 (once) to 22. Scutes, 28 to 30; straight part lateral line in chord of its curve, 1.1 to 1.2. Ridge on top of head present.

We are assuming that the Manila form and the Honolulu form occur together in the Bonin Islands, and being very divergent forms that they do so as would distinct species, though neither is specifically separable from cosmopolitan *crumenophthalmus*. Differences in dentition given by Wakiya I am unable to verify; and may note that teeth in this genus are variable and change considerably with age.

TAXONOMY.—The conservative course is to follow Wakiya and identify our Honolulu form with *Caranx torvus* Jenyns, 1841, 'Zool. Voy. "Beagle,"' p. 69, Pl. xv, Tahiti, and it may stand as *Trachurops crumenophthalmus torva* (Jenyns); to identify our Manila form with *Caranx macrophthalmus* Rüppell, 1828, 'Atl. Reise Nord. Afr.,' p. 97, Pl. xxv, fig. 4, Red Sea, and this may stand as *Trachurops crumenophthalmus macrophthalmus* (Rüppell). However, I have examined Jenyns' and Rüppell's figures carefully, and, whereas they are unquestionably suggestive of these two forms, respectively, I suspect they are based on less aberrant fish not worth taxonomic recognition. Also the general study of variation in the species makes this seem more likely than that these remote individuals should be identical with Honolulu and Manila forms. If it proves to be the case, I would prefer

to recognize these forms from their narrower range as indicated above, though it should necessitate naming them anew. A small specimen to hand, 109 mm. standard length, from Sagami (No. 500, Amer. Mus. Nat. Hist., probably collected by Bashford Dean), seems to be the Honolulu form and corroborates Wakiya's reference to it (as *S. torvus*) from Japan.

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THE TIFFANY FAUNA, UPPER PALEOCENE

II.—STRUCTURE AND RELATIONSHIPS OF *Plesiadapis*

BY GEORGE GAYLORD SIMPSON

In 1854 Charlesworth gave the name *Platychoerops richardsonii* to a fragmentary palate from the London Clay, and in 1865 Owen renamed the same specimen *Miolophus planiceps*, and considered it as a relative of the hyracotheres. It was, in fact, a primate, the first discovered member of a very strange and primitive group, but its affinities were not recognized, even approximately, until Teilhard rescued it from oblivion in 1921, sixty-seven years after its first description. In the meantime a still older animal of closely similar character had been found at Cernay, near Rheims, by Lemoine, on whose first specimens Gervais based the genus and species *Plesiadapis tricuspidens* in 1877. Lemoine later described many additional specimens discovered by him. As a result of his work, most of the dentition was made known.¹

Stehlin, in 1916, gave some much more satisfactory figures of *Plesiadapis* teeth from Cernay, and also named a new very closely related form, *Chiromyoides campanicus*, from the same locality. Teilhard revised and refigured Lemoine's material in 1921, giving full and accurate data on all the parts of the commoner Cernay animal so far discovered and preserved. He also showed that *Platychoerops* is a close relative of *Plesiadapis*.² Meanwhile, in 1915, Matthew had described an American genus and species, *Nothodectes dubius*, from a fragmentary jaw, the relationship of which with *Plesiadapis* was not at first recognized. In 1916 Granger, collecting in the beds later named Tiffany, in southwestern Colorado, found a small pocket of bones, the Mason Pocket, which proved to include remains of "*Nothodectes*" (*Plesiadapis*) as the commonest genus. In 1917 Matthew described the dentition as revealed by these specimens, then noting the close similarity to, and possible identity with, *Plesiadapis*. Teilhard (1921) considered *Nothodectes* as definitely synonymous with *Plesiadapis*, and in this all later students follow him.

¹ He also mentioned a number of skull and skeletal parts, but, except for the distal end of the humerus, these either proved to belong to other genera or were lost without having been adequately described.

² He considered them as identical, but in this I cannot follow him.

Matthew mentioned the existence of more and better material than he described in 1917, including parts of the skeleton, but preparation was not then completed and description was deferred. Gregory (1920) again mentioned the existence of this material, and briefly described a humerus from it. A full description, however, has never appeared.

In reviewing and more fully describing the Tiffany fauna, Doctor Granger's kindness in turning this invaluable collection over to me for study gave me the opportunity of preparing a description of all specimens of *Plesiadapis gidleyi*. The material being so much more complete than for any other animal in the fauna, its consideration overbalances the remainder of the review of the Tiffany fauna, and it is accordingly published as a separate part of the revision. All the morphological data and discussion of affinities are here presented. The minor points of differences between *Plesiadapis* and related genera (*Pronothodectes*, *Chiro-myoides*, and *Platychoerops*) and the diagnosis of the several known species of *Plesiadapis* are given in the next (last) section of the Tiffany revision.

Unless otherwise noted, the following description is based on *Plesiadapis gidleyi*, which seems to be fairly representative of the genus and is incomparably the best known species. No part is known in another species and unknown in *P. gidleyi*, so that this description of the latter is nearly exhaustive of present knowledge of the genus as a whole.

MORPHOLOGY

DENTITION.—The dentition of *Plesiadapis* is already very well known from the detailed descriptions of the European specimens by Lemoine (various papers, see reference), Stehlin (1916), and Teilhard (1921), of many of the present specimens by Matthew (1917), and of other American species by Jepsen (1930). The teeth will therefore not be redescribed in detail, but a few additions and observations on obscure points or differences of interpretation must be made.

Matthew mentions a minute and doubtful vestige of an incisor anterior to the enlarged upper incisor, but it seems to me too doubtful to have any positive value. The enlarged tooth may be either I¹ or I². As Matthew stated, the maxillo-premaxillary suture is indeterminable, but his belief that there are two incisors followed by a canine seems highly probable and is in part confirmed by a bone fragment with the first two teeth, Amer. Mus. No. 17404, which appears to be a disarticulated premaxilla.

In two specimens, P² has a small and low but distinct inner cusplule

or incipient protocone, but on another (the type) this is absent, or represented only by a very slight basal swelling, and the whole tooth is relatively smaller.

The protoconule of P^{3-4} does not have the same structure as that of the molars. It is conical, not crescentic as in the molars, is closely applied to the paracone base, not well separated, and has no connection with the protocone-paracone crest which passes anterior to it, not through it as on the molars. This and the absence of metaconule and mesostyle are the principal distinctions (aside from size and proportions) between P^{3-4} and M^{1-2} .

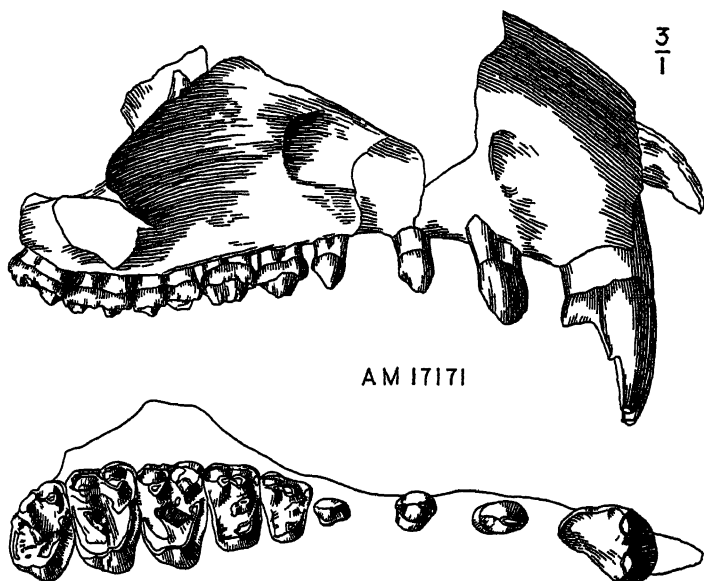


Fig. 1. *Plesiadapis gidleyi*. Right upper teeth, Amer. Mus. No. 17171. External and crown views. Three times natural size.

The upper molars have been very fully and accurately described.

P_2 is apparently absent in all other known species, but the alveolus is indicated in all specimens of *P. gidleyi* that show this region clearly. In the type the crown is present on both sides. It is exceedingly small, globular with an obscure apical pattern, and practically functionless although it is worn. As noted by Jepsen for another species, the flattened posterior faces of the protoconids of P_{3-4} bear three radiating ridges separated by two strong grooves. The heel of P_3 and that of P_4 are each

formed by a transverse crest, but the structure is slightly more advanced than this statement alone indicates. In both cases the crest bears two apices or cusps, and on P_4 another cusp, much smaller and variable, tends to appear between these. There is also a distinct tendency, especially on P_4 , to enclose a heel basin by longitudinal lateral ridges, but these are always weak and the basin shallow.

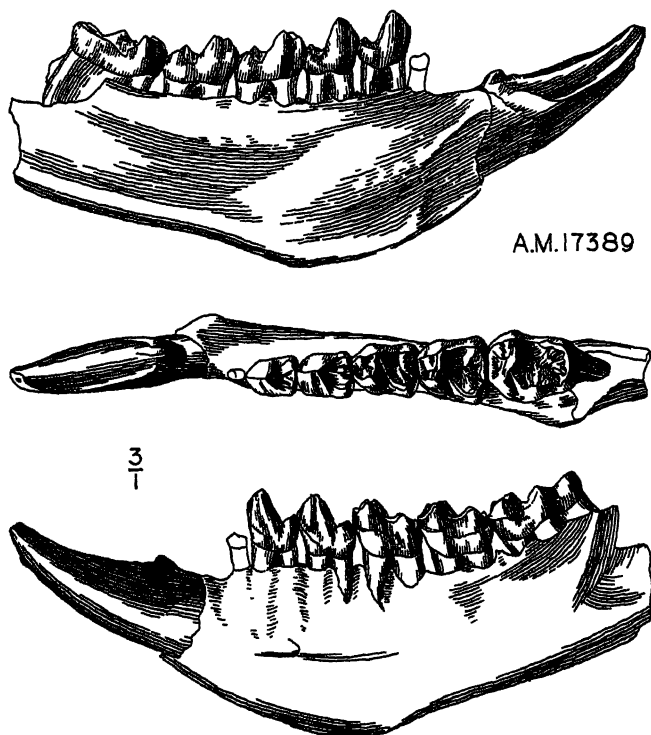


Fig. 2. *Plesiadapis gidleyi*. Left lower jaw, Amer. Mus. No. 17389. P_2 , in outline, supplied from No. 17170. Internal, crown, and external views. Three times natural size.

On M_1 a shelf originates on the posterior side of the metaconid apex and passes obliquely down the flat posterior face of the trigonid to its base at the midline, where the shelf joins the hypoconid-trigonid crest. The latter crest reaches the trigonid at successively more external points on M_2 and M_3 , and on these teeth the shelf alluded to apparently is quite absent even on unworn specimens. A constant feature of the trigonid is a deep short groove on the metaconid slope which falls into the trigonid

basin. Matthew (1917, p. 835) describes M_2 as having no paraconid but with "the metaconid . . . obscurely twinned, the posterior cusp having rather the relations of a metastylid." Teilhard (1921, p. 23) stated that in *Plesiadapis tricuspidens* the paraconid is distinct on M_{2-3} and suggested that in that species and also in *P. gidleyi* Matthew's metaconid is the paraconid, his metastylid the metaconid, and an obscure rudiment not mentioned by Matthew the incipient metastylid. Reviewing Matthew's material (which did not include all the Tiffany specimens, some being unprepared when he wrote), it is clear that he has described a morphological condition by giving his conclusion concerning its interpretation, rather than going into detail regarding the actual topographic details (a valid practise, in the interests of brevity, common in Matthew's work). The implied topography is the presence on M_1 , but not on M_{2-3} , of the shelf described above, the fact that the inner trigonid cusps are much more nearly connate on M_{2-3} than on M_1 , and the fact that on his specimens the anterior of these two cusps is or seems to be larger, the reverse of the usual condition among primates (and most other groups) when the paraconid is disappearing by fusion with the metaconids. On the least worn material (not seen by Matthew), however, the two cusps are generally of equal size or the posterior slightly larger. The posterior cusp has the essential characters of the metaconid of M_1 , being united by a crest to the protoconid and bearing the groove on the trigonid side mentioned above. The probable metastylid rudiment mentioned by Teilhard is also distinctly visible on M_{2-3} , although only the faintest hint of it is seen on M_1 even when completely unworn. The homologies suggested by Teilhard are thus almost surely correct, although the topographic peculiarities implied by Matthew are present and very distinctive.

There is a distinct hypostylid on the hypoconid-trigonid crest, on M_{1-3} in *P. gidleyi*, made especially distinctive on M_3 by the presence of a notch, stronger than on M_{1-2} , between it and the hypoconid on the basin side of the crest. The talonid basins are not fully closed on any of the lower molars, the notch between entoconid and metaconid being open and almost as deep as the adjacent deepest part of the basin.

The talonid of M_3 is extended into a strong third lobe, as often described, but this is rarely or never as wide (does not extend so far externally) as the second lobe.¹ The hypoconid is distinct and separated by

¹ The tooth figured by Teilhard (1921) in his Plate 1, fig. 11, is an apparent exception, but I cannot believe that this tooth belongs to *Plesiadapis*. Judging from the photograph, the third lobe is as long and wide as the second and larger than the first (trigonid), it is notched at the midline posteriorly, the trigonid is shorter than in *Plesiadapis*, and the internal trigonid cusp is either single or much less clearly double than in *Plesiadapis*. All these characters suggest *Phenacolemur* and the tooth may indicate the presence of an ally of that genus in the Cernaysian.

definite marginal notches from adjacent parts but the remainder of the talonid margin is essentially continuous, with an elevated rim on posterior and posterointernal sides. This is very obscurely divisible into cusps but generally a posteroexternal cusp and a slightly more anterior, lower, internal cusp (entoconid, which is thus part of the ridge and not distinct or opposite the hypoconid) can be distinguished. The rim between these may suggest a single elongate cusp or may itself be obscurely double. The enamel of the basin is highly rugose, even more so than on M_{1-2} .

Lemoine (1891, p. 280 and Pl. x, fig. 69e) described and figured a specimen with an unerupted permanent incisor, Dm_3 , unerupted P_{3-4} and erupted M_{1-2} . His discussion goes no farther than to point out that there were three milk teeth in the lower jaw.¹ He also figured (Pl. x, fig. 70s) a tooth tentatively considered Dm_4 . Its heel is so unlike that of Dm_4 in *P. girdleyi* that the reference is open to grave doubt.

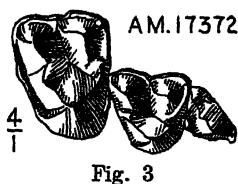


Fig. 3. *Plesiadapis girdleyi*. Dm_{3-4} and M^1 , Amer. Mus. No. 17372. Crown view. Four times natural size.



Fig. 4. *Plesiadapis girdleyi*. Dm_{3-4} , Amer. Mus. No. 17372. Crown view. Four times natural size.

In the present material Dm_{3-4}^{3-4} are present in Amer. Mus. No. 17372, and there are three other specimens with milk teeth. Dm^3 has a triangular, sharp main cusp, on the posterior crest of which a minute metacone is visible. Parastyle and metastyle are both prominent, the latter larger. A very small posterointernal cuspule united by cingula to the two styles represents an incipient protocone. Dm^4 is fully molariform but of very different proportions from M^1 , the length being nearly equal to the latter but the width little over half as great. The conules are relatively smaller, and the posterior cingulum is less expanded, although of identical structure otherwise.

Dm_3 is an elongate, triangular tooth. It has a minute rudiment of a metaconid, but the paraconid is suggested only by an angulation in the

¹ Only one was preserved, but from their unerupted condition he inferred, correctly no doubt, that the incisors and P_4 also had deciduous predecessors.

anterior crest. There is a small, basined bicuspid heel. Dm_4 is identical with M_1 in the general structure and relationship of all its cusps and crests but it is narrower throughout, the trigonid is narrower relative to the talonid, the trigonid is more elongate and triangular, and the paraconid is more distinct and projecting.

Dm^2 may possibly be represented in Amer. Mus. No. 17387 by an extraordinarily minute, one-rooted tooth with a blunt, formless crown, or termination. On this same specimen Dm^3 has the protocone still smaller than in Amer. Mus. No. 17372, the anterointernal cingulum absent, and no trace of a metacone. These are clearly individual variations.

SKULL.—Lemoine (1887, p. 190) briefly described skull parts from Cernay referred to *Plesiadapis* as follows: "C'est tout d'abord la plus grande partie d'une boîte crânienne indiquant une tête aplatie, plus large et moins longue que celle du *Pleuraspidothierium* et de l'*Orthaspidothierium*. La crête arrondie que surmonte l'occipital est fort développée et contraste avec le peu de saillie de la crête interpariétale. L'empreinte cérébrale se trouve bien conservée et indique l'égalité relative et l'indépendance des trois parties constituant de l'encéphale: cerveau antérieur, cerveau moyen, cerveau postérieur ou cervelet. La surface du cerveau proprement dit du *Plesiadapis* paraît avoir été moins lisse que chez le *Pleuraspidothierium*. Deux autres fragments fournissent des indications sur la base du crâne et sur la constitution de l'oreille tant interne qu'externe, celle-ci largement ouverte au dehors."

This description is too general to be of any assistance in determining the affinities of the genus, and no later or more detailed data are available.¹ Teilhard (1921) did not find the specimens mentioned in the collection. It cannot be considered quite certain that they did belong to *Plesiadapis*, several skeletal elements described by Lemoine in the same paper having proved to be of other genera.

In the *P. gidleyi* material the palate, sides of the face, and a few basicranial characters can be made out.

The palate is long and of nearly equal width throughout. It is entire, even the anterior palatal foramina apparently being small, although not clearly shown. The choanae extended little, if at all, between the molars.

The zygoma arises opposite M_2 and beneath the orbit was expanded vertically (not horizontally as in *Tarsius* and so implying smaller orbits than in the latter), apparently deeper than in *Tupaia* and shallower than

¹ Osborn (1890), cited by Teilhard, gives only an abstract of this passage by Lemoine, and Schlosser's statements as to the skull are also wholly based on Lemoine.

in *Daubentonia*, much as in primitive lemurs. The infraorbital foramen is single and is above P_3 . The face between this foramen and the anterior zygomatic rim is excavated. The lacrimal foramen is single, large, its canal diverted forward and downward, and it lies on the orbital rim near where the latter passes into the zygoma. It is thus marginal, but rather nearer being inside than outside the orbit. The lacrimal sutures cannot be surely made out, but the facial expansion was apparently small or absent. The lacrimal region appears to have been almost exactly as in *Notharctus* and *Adapis*. The distance between the bases of the median orbital walls is probably almost accurately shown in one specimen and is more than in *Tarsius*, less than in *Daubentonia*, and about as in generalized lemurs, again suggesting a moderate, lemuroid degree of orbital expansion without the peculiar structural lines of *Daubentonia*.

Much of the basicranium is present in Amer. Mus. No. 17388, but it has been crushed flat and broken into small disarranged fragments so that few characters can be determined. The pterygoid crest was evidently bifid as in tupaoids and primates generally, but its details are not clear enough to indicate any more specific resemblance, except that the somewhat distinctive type in *Daubentonia* is not indicated. The glenoid surface is flat with length and breadth about equal, and there is a small, discrete postglenoid process with a foramen at its inner edge, very much as in *Notharctus* and *Lemur* and less like *Tupaia*, *Tarsius*, or *Daubentonia*.

The bulla is completely ossified, but is remarkably small and relatively little inflated, less so than in any of the tupaoids or lower primates with which I am familiar. There was apparently no ossified external meatus. There are traces of the anterior lacerate foramen in its normal position and of closely approximated condylar and posterior lacerate foramina. The internal carotid almost certainly did not enter anywhere along the median side of the bulla, and there is evidence of a foramen at the posteroexternal corner of the bulla which is probably for this artery. So far as details of the ear region can be seen, they are not inconsistent with comparison with tupaoids, generalized lemuroids, or *Daubentonia*, but differ in the less expanded bulla and corresponding modifications. The general aspect is that of a small-bullaed *Notharctus*, but this may be superficial. The resemblance to *Tarsius* seems considerably more distant, but details are too few and too obscure for any very strong conclusion.

MANDIBLE.—The symphysis is unfused throughout life. In keeping with the rodent-like habitus, the straight cheek tooth series is implanted somewhat obliquely, so that the opposite rows are parallel. The symphysis is procumbent and inclined at about 30° from the horizontal,

more inclined than in *Daubentonia* and slightly less than in recent tupaioids. There is no mental prominence, but the deepest part of the jaw is at the posterior end of the symphysis, beneath P_{3-4} . Although more slender posterior to this point, the horizontal ramus is rather deep throughout. There are two mental foramina: one, larger, beneath the anterior root of P_3 and the other beneath the posterior root of P_4 . Posterior to the molar region, the lower border of the mandible curves upward, then slightly downward again at the beginning of the angular process. This is a prominent, flattened, somewhat hooklike process curving backward and slightly downward. The condyle is far above the molar level and is moderately transverse, although its articular surface is

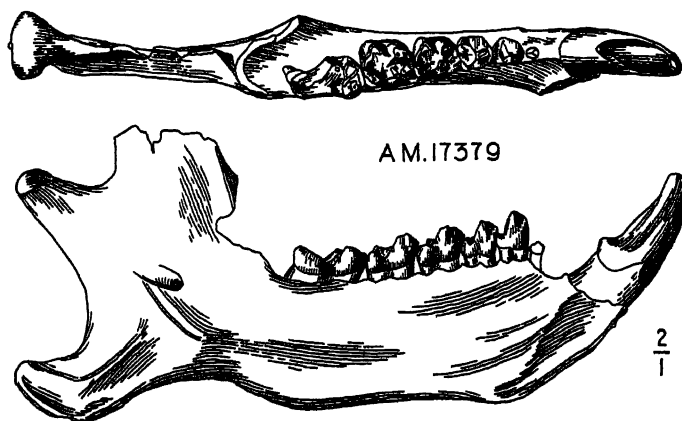


Fig. 5. *Plesiadapis gidleyi*. Left lower jaw, Amer. Mus. No. 17379. Superior and internal views. Twice natural size.

not cylindrical but rather evenly convex and mainly on the upper surface. The corono-condylar notch is deep and rather narrow. The coronoid is not completely preserved in any case, but clearly was high and broad anteroposteriorly. The base of the coronoid does not extend anterior to the middle of M_3 . The masseteric fossa is broad and nearly flat, deep anteriorly and here bounded by stout, but not sharp, ridges. The inner surface of the posterior part of the mandible is nearly plane but has a prominent ridge along the lower border of the angle and extending forward and upward a short distance onto the horizontal ramus. On the angular process there is another small but sharp ridge above and parallel to this. The dental foramen is at the alveolar level but far posterior

to the alveoli. From its posteroinferior point a definite mylohyoid groove extends downward and forward.

With slight superficial differences correlated with the rodent-like habitus, the mandible as a whole resembles that of *Lemur* in basic type but differs somewhat from the lemuroids and decidedly from all other primates in the less broadened, more projecting angular process, in this feature being more like the tupaoids, which, indeed, it resembles throughout except for the rodent-like adaptive characters and the generally much heavier build. It is extraordinary that despite the somewhat similar adaptive dental type, the lower jaw is very unlike that of *Daubentonia* in almost every character.

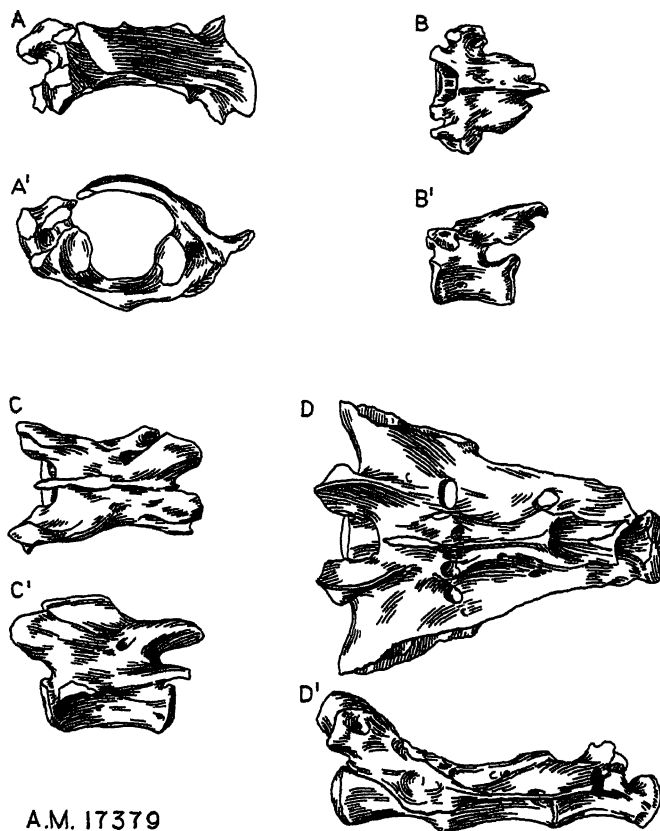
VERTEBRAE.—The structure of the atlas is fully visible in Amer. Mus. No. 17379, and in every essential it agrees with *Lemur*. Indeed I see no character of this bone in *Plesiadapis* not exactly matched in one or another of the rather variable atlases of *Lemur* and its close allies, with the single possible exception of the cotylus, which in *Plesiadapis* has the long axis at a smaller angle from the horizontal and its upper outer portion is less concave, the lip less produced. Comparison with the loriforms, in which the atlas is quite distinctive from that of the true lemurs, is much less close and *Tarsius* also has a highly modified atlas different from this type. *Daubentonia* has a *Lemur*-like atlas, and to that extent is also like *Plesiadapis*, but the latter is closer to *Lemur* in exact details. The tupaoid atlas differs more from that of *Plesiadapis* than do either *Lemur* or *Daubentonia*.

Parts of the other cervicals are present in Amer. Mus. No. 17388, but aside from their having primitive primate general proportions, nothing definite can be made out.

In Amer. Mus. No. 17379 two mid-dorsals, six lumbar, the sacrum, and two anterior caudals are preserved and have been wholly freed from the matrix.

The two dorsals are closely similar save that one, presumably more anterior, has slightly longer transverse process. The centrum is longer than broad and broader than deep and has a single or vaguely double rounded ventral ridge with a prominent foramen in the concavity on each side. The transverse processes are pedunculate, with expanded ends. The neural notches are large and deep, reaching to the posterior edges of the transverse processes. The roof of the arch is very little elevated and is smoothly convex transversely. The zygapophyses are little differentiated from the arch. The articular surfaces of the postzygapophyses are very gently concave and face downward and slightly inward. Success-

sive vertebrae of this region overlap dorsally like a series of scales. The neural spines are slightly broken, but probably they were short. Each is small and styliform, springs from the extreme posterior end of the arch, and is directed strongly backward, little upward. Of the types with which I have compared them, these vertebrae are definitely more like the lemurs,



A.M. 17379

Fig. 6. *Plesiadapis gidleyi*. Parts of vertebral column, Amer. Mus. No. 17379. A dorsal, and A' posterior views of atlas. B dorsal, and B' left lateral views of dorsal vertebra. C dorsal, and C' left lateral views of lumbar vertebra. D dorsal and D' left lateral views of sacrum. All twice natural size.

but the transverse processes are slightly shorter and stouter (but figures of other lemur skeletons suggest that this is not true of all) and the neural spine markedly less erect in *Plesiadapis*. *Daubentonius* is equally different in these characters and also has quite different proportions, and

Tarsius is still more unlike the fossil. The vertebrae of *Tupaia* are similar to the extent that they are lemur-like.

Five of the six preserved lumbar differ chiefly in size, becoming larger posteriorly. The centrum in each case is elongate and moderately depressed. Its ventral ridge is broad and flattened on the more anterior and sharp on the more posterior lumbar. The more anterior vertebrae apparently had only slight swellings in the position of the transverse processes, but the more posterior have broken bases which probably supported small but projecting anterior transverse processes. The neural notch is much shallower than on the dorsals. All six of these vertebrae have strong typically primate anapophyses, and the zygapophyses are well differentiated and also of normal, primitive primate type. The spine is adequately preserved in only one case, there being low, squarely truncated, long anteroposteriorly, and directed forward.

The other preserved lumbar was still more posterior and was probably the second (possibly the first) in front of the sacrum. It is still larger than the most posterior of the others, has a transverse process running the full length of the base of the neural arch (broken off on each side), no separate anapophysis, the spine shorter anteroposteriorly but more erect and probably higher.

These vertebrae are somewhat more strongly ridged ventrally than in *Lemur*, the spine is slightly different in shape, and there are other very minor differences but the general agreement is remarkably close. The distinctions (apparently not very important) between either *Tupaia* or *Daubentonina* from *Lemur* in this region are in each case equally distinctions from *Plesiadapis*, and *Tarsius* is quite definitely unlike *Plesiadapis*.

The sacrum is formed of three fused vertebrae, the first broadened and the others elongate, all with strongly depressed centra. The sacrum differs from that of *Lemur* chiefly in having the transverse processes of the first vertebrae longer and more flaring, elevated at the ends, the iliac scar more elongate and its long axis at a larger angle to the long axis of the sacral centra. The iliac articulation was almost entirely with the first vertebra (as in *Lemur*). The other transverse processes are somewhat broken.

The peculiarities of the tupaoid sacrum with respect to *Lemur*, such as the quadrate outline, reduction of the foramina between the transverse processes, or fusion of the spines, are all also distinctions from *Plesiadapis*. *Daubentonina* also differs in its non-Lemur-like characters, which are more numerous and definite than in *Tupaia*. *Tarsius*, however, is about as similar to *Plesiadapis* as is *Lemur*, but not more so.

The two anterior caudals are similar, but one has the centrum slightly keeled, the other not. These vertebrae are smaller than the posterior lumbar. Length and width of centrum are about equal, the depth much less. There were strong transverse processes (ends broken off). The neural arch is of the same type as that of the posterior lumbar, but smaller and with the zygapophysial facets farther from the vertical. There are small erect neural spines.

RIBS.—There are numerous rib fragments, but they show nothing of interest except that the ribs are slender and normal.

SCAPULA.—Part of a left scapula is associated with Amer. Mus. No. 17379. The parts preserved are almost exactly as in the tupaoids and Madagascar lemurs, the regions in which these very closely similar types differ not being preserved, except that the lower part of the prespinous fossa is wide, more as in tupaoids, and that the upper part of the postspinous fossa is concave and not flattened, more as in *Lemur*. The peculiarly rodlike type of *Tarsius* is not suggested. *Daubentonius* almost exactly resembles *Lemur* in these parts, except for the flattening of the postspinous fossa, a difference from the fossil.

HUMERUS.—The nearly complete right humerus of Amer. Mus. No. 17379 has already been figured and described by Gregory (1920, p. 70 and Pl. XXVII). He points out that this bone in *Plesiadapis* ("*Nothodectes*") differs from that of *Notharctus* as follows:

- (1) The delto-pectoral crest is very thin and acutely V-shaped, as seen from the outer side, ending below in a prominent pointed tip.
- (2) The supinator crest is not so large as it is in *Notharctus* and does not extend up to the level of the deltoid tip.
- (3) The trochlea is relatively larger and more extended vertically.
- (4) The tuberosity for the teres major, on the inner side of the shaft, is much larger and more sharply defined.

In place of (3) I would write:

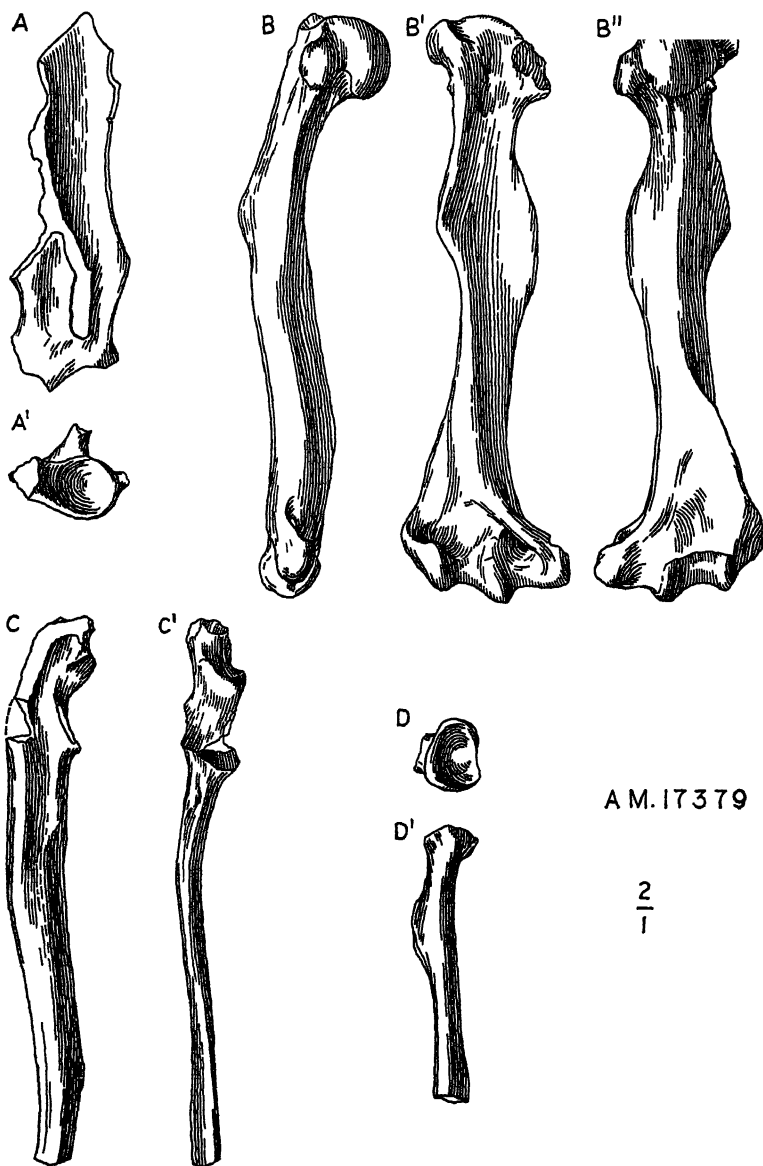
- (3) The trochlea has only a faint suggestion of the cylindrical form and outer lip typical of modern lemurs, *Notharctus* being approximately intermediate in this respect between the latter and *Plesiadapis*.

And I would add:

- (5) The shaft as a whole is more curved and sigmoid.
- (6) The entepicondylar foramen is more distal, nearer but more lateral to the trochlea.

With the exception of (2), which is a definite resemblance to modern lemurs, these are all also differences from *Lemur* and its allies.

The general habitus and curvature suggest *Tarsius*, but this is an adaptive feature and *Plesiadapis* has none of the special peculiarities of



AM. 17379

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Fig. 7. *Plesiadapis gidleyi*. Parts of anterior limb, Amer. Mus. No. 17379. A lateral and A' distal views of part of scapula. B internal, B' anterior, and B'' posterior views of humerus. C internal and C' anterior views of broken ulna. D proximal and D' (approximately) internal views of part of radius. All twice natural size.

the *Tarsius* humerus, and it also lacks the peculiarities of *Daubentonina*, notably the specialization of the supinator crest, being more *Lemur*-like than either of these.

As Gregory notes, the humerus of *Ptilocercus* could be derived from that of *Plesiadapis*, but so could that of *Lemur*, and looking at the matter in a different way I do not see that the resemblance to *Ptilocercus* is specific, going beyond what could be expressed by calling both lemuroid. (1), (4), (5), and (6) are as unlike *Ptilocercus* as *Lemur*. In (2) *Plesiadapis* is more like *Lemur* than like *Ptilocercus*. In (3) *Ptilocercus* is a little like *Plesiadapis* in being slightly more primitive than is *Lemur* itself, but *Plesiadapis* is as near to *Notharctus* as to *Ptilocercus* in this respect. In résumé, it seems accurate to say that *Ptilocercus* closely resembles the lemurids in the humerus, that *Plesiadapis* resembles them also but less closely, and that the humerus of *Plesiadapis* is at least as much like that of lemurids as like that of any tupaoid. I therefore cannot share Gregory's opinion that the humerus of *Plesiadapis* gives evidence that the Plesiadapidae are tupaoids¹ and not lemuroids.

The humerus referred by Lemoine and doubtfully by Teilhard (1921, Pl. I, fig. 33) differs in the less produced entepicondyle and slightly larger and more proximal foramen, but could well be congeneric.

RADIUS.—The proximal half of the right radius is present in Amer. Mus. No. 17379. It differs from that of *Lemur* chiefly in having the fovea oval rather than circular and with its rim narrower and sharper and in lacking the pit on the neck above the tuberosity. The bone is broken just at this point, but there appears to have been an eminence for the pronator teres. This and the oval fovea are tupaoid characteristics, but the first is equally present in *Notharctus* and the latter suggested. In tupaoids the tuberosity is much weaker. In *Daubentonina* the head is circular and the tuberosity and pronator eminence are much weaker. *Tarsius* differs still more markedly.

ULNA.—Most of the left ulna, lacking the distal end, is preserved in the same specimen, and there is another fragment, the proximal end of a right ulna lacking the olecranon. The sigmoid notch is somewhat shallower and longer relative to its width than in *Lemur*, the proximal portion also somewhat larger relatively and more strongly curved (convex). All these characters are resemblances to *Notharctus*. As in *Lemur* but not in *Notharctus* a small crest separates the articulations for the humerus and for the radius. The olecranon is relatively a little shorter than in *Lemur*, but otherwise closely similar, as is the whole proximal end. As in

¹"Menotyphla," but the comparison is with tupaoids.

Lemur, a sharp crest appears on the lateral side of the distal part of the shaft, but anterior (or interosseous) and posterior borders are also sharply crested here and the surfaces between the three crests are all concave. This differs from *Lemur* and also (but rather less) from *Notharctus*, but is rather closely approached in *Perodicticus*. The resemblance of the ulna as a whole to the tupaoids seems to involve only characters that are also lemurid, and to be somewhat more distant than to the lemurids. Exactly the same statement could be made substituting "*Daubentonia*" and "*Tarsius*" for "tupaoids." The bone, as preserved, has indeed a peculiar twist distal to the sigmoid notch which is also suggested in *Tarsius*, and not in the other forms compared, but this may be, and I think probably is, due to crushing.

METACARPAL.—In probable association with Amer. Mus. No. 17379 is a bone of appropriate size and structure to be a third or fourth meta-

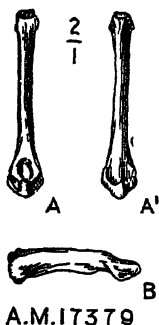


Fig. 8. *Plesiadapis gidleyi*. Foot bones, Amer. Mus. No. 17379. A dorsal and A' palmar views of (?) metacarpal. B, lateral view of phalanx (probably of pes). Twice natural size.

carpal of *Plesiadapis gidleyi*. The proximal articulation is very simple, with the form of a truncated triangle, wider dorsally, convex in the dorso-palmar direction and plane transversely. The shaft is simple, slender, widening distally, and nearly circular in section. The distal end is very peculiar, of a type approached by tupaoids and primitive insectivores but not achieved, in specialization, in any form examined by me. A medial pit on the dorsal surface is followed distally by a spherical articular process which on the palmar side continues into two earlike posterolateral wings. There is also a short but prominent median palmar keel.

PELVIS.—The pelvis is not present in the best specimen, Amer. Mus. No. 17379, but Amer. Mus. No. 17409 is a nearly complete, isolated left half of a pelvis, lacking only the symphysis and a small part of the anterior end of the ilium, and almost certainly belongs to this species. There are also two other specimens, but they add little or nothing.

The ilium is rodlike and of moderate length. Near its midpoint, where the diameter is least, its section is markedly and almost equilaterally triangular, the superolateral face being 4.0 mm. in width, inferolateral 3.8, and medial 3.5, in one specimen, and in another 3.5, 3.4, and 3.4, respectively. More anteriorly, in the articular region, the superior face flares somewhat, but even here its greatest width (in the smaller specimen mentioned) is only 4.7 mm. while that of the inferior face is 3.6 mm. This relatively slight expansion of the superolateral face is a marked distinction from *Tupaia*, *Notharctus*, or lemurids, but more like the latter as they are the least expanded of the three groups, although still markedly more so than is *Plesiadapis*. *Daubentonia* is as little expanded

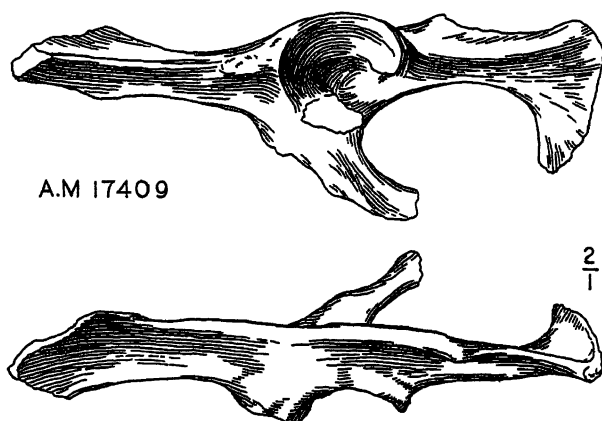


Fig. 9. *Plesiadapis gidleyi*. Pelvis, Amer. Mus. No. 17409. Lateral and dorsal views. Twice natural size.

as is *Plesiadapis*, but its ilium is nevertheless very different, the lateral face not being divided by a crest into superior and inferior parts, and the blade being of nearly equal width throughout and straighter than in *Plesiadapis*. The pelvis of *Tarsius* is so unlike that of *Plesiadapis* in all its distinctive details that comparison is unnecessary. The sacral scar is large and apparently the ilium was less extended anterior to it than in any of the genera used for comparison, but this is uncertain due to the poor preservation of this part in the specimens.

It seems to be a lemurid character, as opposed to tupaoids, higher primates, or even *Daubentonia*, that the angle between the sacral and iliac axes is small. This cannot be exactly determined on our *Plesiadapis*

material, but it appears to be highly probable that the angle was also low in that genus, most nearly comparable to the lemurids.

The anteacetabular spine is large, but thicker and less produced outward and downward than in *Notharctus*, *Lemur*, or *Tupaia*, more like *Daubentonia* in this respect but less differentiated from the acetabular rim than in that genus.

The acetabulum is almost identical in form with that of *Tupaia* or *Lemur*. In *Daubentonia* the upper lip is much reduced.

The ischium is primitive and *Tupaia*-like in being more elongate than in any of the other comparative genera. Correlated with this is the position of the ischial spine (which is prominent, as in *Lemur* and most primitive primates) definitely posterior to the acetabulum, whereas in such later primates as have it, it is nearly above the posterior acetabular rim. In *Tupaia* it is slightly more posterior than in *Plesiadaps*. The ischial tuberosity is very slight, even less expanded than in most lemurs and definitely less than in *Notharctus*, in which it is larger than in modern lemurs, markedly unlike that of *Daubentonia*, and closely similar to the primitive condition of *Tupaia*. The inferior ramus of the ischium, although incompletely preserved, is clearly of the slender lemuroid type, much less expanded than in *Daubentonia* and slightly less than in *Tupaia* (but cf. *Ptilocercus*). It was probably directed slightly less anteriorly than in *Lemur*, and more as in *Tupaia*. The upper and anterior margins of the obturator foramen are much as in *Tupaia*, and probably the symphysis was also. This is unquestionably primitive in comparison with the slight modifications seen in *Lemur*.

What is preserved of the pubis is exactly like *Lemur* or *Tupaia*, these genera not differing significantly in this part, and noticeably less like *Daubentonia*.

FEMUR.—The proximal end of the femur is preserved in association with Amer. Mus. No. 17379, and there is also an isolated distal end, poorly preserved but showing the essential characters. The length is not determinable.

The head is spherical and the neck constricted, as in *Tupaia* and *Lemur* and unlike *Notharctus*. The greater trochanter extends as far as the head proximally, as in *Tupaia* (but not *Ptilocercus*); in *Ptilocercus* and *Notharctus* it does not extend so far, and in *Lemur* it extends farther. The general shape and development of the greater trochanter is very lemur-like, but the external surface is less expanded and the notch between the trochanter and the head is deeper, both primitive characters and resemblances to *Tupaia*. The intertrochanteric ridge is low and

barely visible, as in all comparable forms, and does not extend relatively as far down the shaft as in *Tupaia*, *Lemur*, or related forms.

The lesser trochanter is enormously developed, somewhat more so

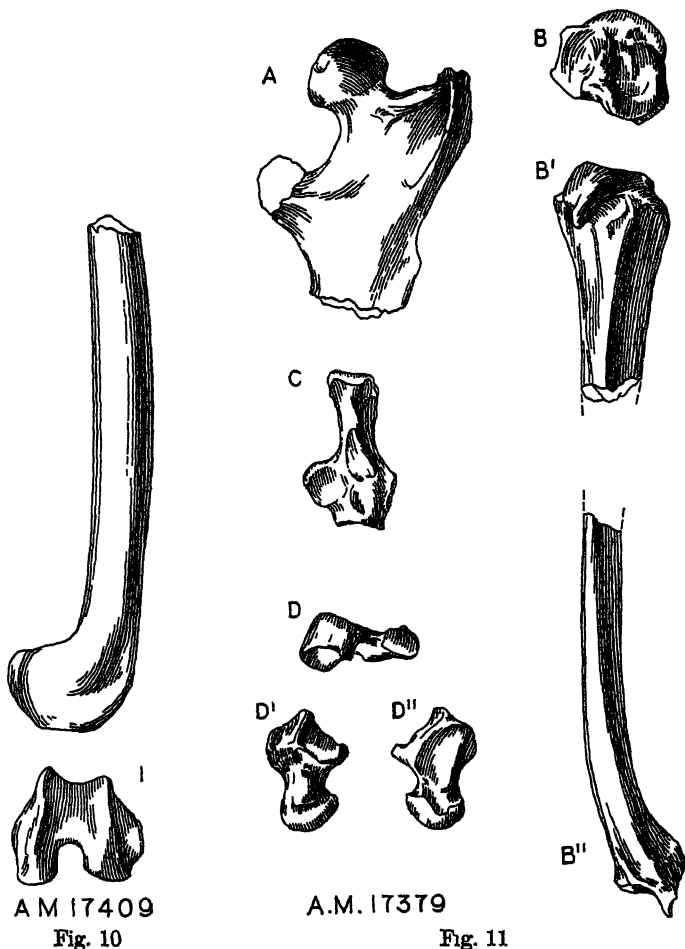


Fig. 10. *Plesiadapis gidleyi*. Distal part of femur, Amer. Mus. No. 17409 (not certainly associated with pelvis of preceding figure). Lateral and distal views. Twice natural size.

Fig. 11. *Plesiadapis gidleyi*. Hind limb bones. Amer. Mus. No. 17379. A posterior view of proximal end of femur. B proximal and B' approximately external views of proximal end of tibia. B'' posterior view of distal end of tibia. C dorsal view of calcaneum. D external, D' plantar, and D'' dorsal views of astragalus. All twice natural size.

than in any genus with which comparison has been made, although enlargement of this process is typical of all the lower primates. It is fully internal, is directed upward and inward, and projects slightly farther than does the head of the femur. The end is rounded and is convex on the posterior and excavated on the anterior surface, somewhat as in *Lemur* in which, however, the trochanter is much smaller and is directed less upward.

A distinct third trochanter also occurs and is more elongate and thinner than in *Lemur*, more like *Tupaia*. In *Daubentonius* this process is smaller and is above the level of the lesser trochanter. In *Lemur* (and *Notharctus*) it is opposite the lesser trochanter. In *Plesiadapis* it is below the latter and in *Tupaia* is still farther down the shaft than in *Plesiadapis*. In this character, as in a number of others noted, *Tupaia-Plesiadapis-Lemur* form a progressive structural series. The most obviously distinctive character of the distal end of the femur in this series is that of the patellar groove. In *Tupaia* it is very shallow, broad, symmetrical, and sharply keeled on both sides. In *Lemur* it is narrower, deeper, and the external keel is higher and more rounded. In *Plesiadapis* it is intermediate in width, depth, and symmetry, but the external keel is as sharp as in *Tupaia*.

TIBIA.—In Amer. Mus. No. 17379 proximal and distal ends of the right tibia, both slightly damaged, are present but the shaft is incomplete. There is also an isolated and imperfect right proximal end of a smaller, but conspecific, tibia. The proximal facets differ from *Lemur* in no significant respect, but the proximal part of the shaft is peculiar. The cnemial crest is weaker than in *Tupaia*, and hence more *Lemur*-like but the lower anterior tuberosity (Gregory) is either not differentiated (cf. *Tupaia*) or lower on the shaft than in *Lemur* (cf. *Notharctus*). There is, however, a definite tuberosity at this level on the internal face of the shaft, suggestive of the condition in the lorisiforms, one of the very few characters more like the lorises than like the lemurs, although even this is far from identity and is probably convergent as the loris tibia is not otherwise particularly close to *Plesiadapis*. There is a definite postero-external crest and also a strong posterior or posteromedian crest, originating above at the posterior margin of the medial condyle. This development of two crests, which converge on the posterior surface not far down shaft, is not seen in any of the other genera examined.

At the distal end the malleolus is produced, as in primates generally, but less than in *Lemur* and with only the slightest suggestion of the hook-like modification so characteristic of *Lemur* and many other primitive

primates. It is also less prominent and sharp than in tupaoids. The surfaces of the trochlear and malleolar facets of the astragalus meet at an open angle, considerably greater than 90° , and are not sharply differentiated.

The fibula is not preserved.

ASTRAGALUS.—The right astragalus and left calcaneum are present with Amer. Mus. No. 17379, and there is an isolated right calcaneum of the same species. This bone seems to have some, and perhaps diagnostic, basic primate characters, but is very much *sui generis*, its marked peculiarities not specifically approaching the tupaoids or any other of the groups compared. Apparently a peculiar habitus of the pes is implied, but lacking fuller evidence this cannot be elucidated.

The body is close to that of *Lemur* in general proportions, but slightly shallower (and much shallower than in *Notharctus*, which exceeds *Lemur* in this dimension). The trochlea is relatively narrow, but very shallow. The fibular crest is sharp and is more prominent than the tibial crest; in lemurs there is tendency to reverse these proportions. The tibial crest is very rounded, is in fact hardly a crest, and the angle between the trochlear and malleolar surfaces is considerably greater than 90° . The ectal facet is relatively open and is smaller than the sustentacular facet, these being rather lemuroid, as opposed specifically to tupaoid characters. The neck is notably shorter and more oblique than in either tupaoids or lemurs and the head is transverse and compressed dorso-ventrally.

In view of the generally close agreement throughout other known parts of the skeleton with lemurs, tupaoids, or both, it is remarkable to find an astragalus of such divergent type in *Plesiadapis*. There can, however, be little question that the bone is correctly referred to this genus. It is of appropriate size, it articulates well with a tibia almost surely of *Plesiadapis*, it was found in apparent association with a partial skeleton of that genus, and there is no other known animal in the fauna to which it could belong with reasonable probability. Some characters suggest other orders, but the general character is not incompatible with primate relationships and the plantar facets are very lemur-like. The astragalus is too peculiar to give decisive evidence of relationship, but would not contradict a hypothesis, strongly based on other evidence, of divergence from an early lemuroid stock.

Teilhard has shown that the astragalus figured by Lemoine as of *Plesiadapis* (1892, Pl. x, fig. 13) is really of *Pleuraspidothorium*, and that

supposed to be of *Platychoerops* ("*Plesiadapis*" *daubrei*, Lemoine, 1892, Pl. x, fig. 14) is probably also erroneously identified and too imperfect to be of value.

CALCANEUM.—The proximal end of the calcaneum and the ectal facet are almost as in *Lemur*. The perineal tubercle is well developed (cf. *Tupaia*), and the sustentaculum is short but strong. The bone ends almost immediately distal to the sustentaculum. The cuboid facet is concave and nearly circular. If the *Lemur* calcaneum had the portion distal to the sustentaculum abbreviated, it would closely resemble that of *Plesiadapis*. It is interesting that this structural change (in reverse order) does seem to have occurred. In *Notharctus* this distal portion is shorter than in *Lemur*, and in *Pelycodus* shorter than in *Notharctus*. In *Adapis*, presumably conservative in this respect, it is nearly as short as in *Plesiadapis*. *Plesiadapis*, however, evidently was not definitely beginning the lemuroid foot specialization, even to the extent that *Tupaia* has done so, but was following a line of its own.

The calcaneum figured by Lemoine (1892, Pl. ix, fig. 16), as of *Orthospidotherium* or *Plesiadapis* is sufficiently similar to the present specimen to be of the latter genus, but the figure is not characteristic enough to make the determination certain.

PHALANX.—A phalanx probably of the pes but indeterminable, is in probable association with Amer. Mus. No. 17379. It is shorter and stouter than the metacarpal described above. The proximal articulation faces backward and slightly upward and is smoothly concave, with a notch between the tuberosities below. The shaft is arched, and has lateral plantar ridges rising into low prominences near the distal end. The distal articulation is almost entirely on the plantar side and is in the form of half a transverse cylinder divided, however, by two grooves into three longitudinal ridges.¹

Among the many isolated bones from the Mason Pocket is another phalanx of this type, and several of a different type which may, nevertheless, also (or instead of that described) belong to *Plesiadapis*. These have the proximal facets concave only in the dorso-plantar direction, the shafts without ridges, and the distal facets pulley-like and extending well up onto the dorsal surface.

¹ Lemoine (1892, Pl. ix, fig. 28) referred a very similar phalanx from the Cernaysian to *Plesiadapis*.

AFFINITIES¹

A number of varied genera, *Apatemys*, *Stehlinella*, *Heterohyus*, and others, were formerly considered as relatives of *Plesiadapis* and placed in the Plesiadapidae, but Jepsen (1934) has recently sorted out this heterogeneous assemblage, placing the genera mentioned and several others in the Apatemyidae. The relationships of the Apatemyidae are not necessarily, or probably, the same as those of the Plesiadapidae and are not here under discussion. The family Plesiadapidae is a distinctive unit, essentially as redefined by Jepsen, including the genera *Pronothodectes* Gidley, *Plesiadapis* Gervais, *Chiromyoides* Stehlin, and *Platychoerops* Charlesworth.² For present purposes it may be assumed that these genera are related to *Plesiadapis* as its only recognizable immediate allies, and only broader relationships will be discussed.

Lemoine's opinion is not very explicit from the point of view of modern taxonomy, but he spoke of *Plesiadapis* as being "lémurien" or as having "des caractères lémuriens avec un facies marsupial" (1887).³ Schlosser at first accepted Lemoine's reference to (or rather comparison with) primates, but later (1892) considered the genus as a rodent, then (1911) as an insectivore, and finally (1923) returned to belief in primate and now in definitely "chiromyiform," affinities. Forsyth Major (1899) considered it as a rodent or duplicidentate. Matthew (e. g., 1914), before he had studied the genus at first hand, referred it to the Insectivora. Stehlin (1916) considered the primate affinities of *Plesiadapis* as beyond any question, and somewhat more tentatively considered it as especially related to "*Chiromys*" (*Daubentonina*). This was accepted by Teilhard (1921) and, largely on the authority of Stehlin and Teilhard, by almost all other students, especially in Europe. It is much the most widespread view in recent literature.

On examining part of the present material, however, Matthew (1917) pointed out the weakness of Stehlin's argument, especially as regards special affinities to *Daubentonina*. He reserved judgment until the skeletal material could be studied (which unfortunately he never was able to carry out), but in the meantime stated tentatively that the

¹ It is impossible to approach the study of an animal as widely known and as much discussed as *Plesiadapis* without having already formed some opinion, however tentative, as to its affinities, and this prejudgment must unconsciously color the emphasis and interpretation of evidence. It should therefore be noted that on starting this study I believed *Plesiadapis* to be perhaps related to *Daubentonina*, as Stehlin believed, or an offshoot of the early tarsioidea, as its primate-like character and association with tarsioidea, before the appearance of known lemuroids, might suggest. The fact that the conclusion reached is decidedly different is, of course, no guarantee that this conclusion is correct, but it does show it to be free from bias.

² Jepsen also places *Plesiolestes* here, but I think it extraneous, and he considers *Platychoerops* as a synonym of *Plesiadapis* while I hold it to be distinguishable generically. These points will be discussed elsewhere.

³ He had also earlier compared *Plesiadapis* with "*Chiromys*," thus anticipating Stehlin (as the latter notes), but apparently he abandoned this comparison.

evidence then before him "suggests that it is a very primitive primate," making no suggestion as to closer affinities. Gregory (1920), however, has more persistently clung to Matthew's and his earlier view that *Plesiadapis* is an insectivore allied to the tupaoids,¹ stating that the humerus gives evidence to this effect which is strengthened by that from many other parts of the skeleton [that described above].

Gidley (1923) pointed out that there are some distinctive dental characters among early primates which are readily recognizable and which do not appear to occur in any other order, and that while some molar types are very equivocal others seem to be infallibly diagnostic of the Primates. He further stated that *Plesiadapis* ("*Nothodectes*") has such a diagnostic molar pattern and is therefore a primate, with little doubt. Comparison was made especially with notharctines and the less specialized platyrrhines.

The general questions thus raised by the various opinions so far expressed² are thus:

1. Whether it is a primate by definition or is not rather an earlier offshoot of the group of Insectivora from which the primates arose.
2. Whether, if it is definitely primate, it is related or ancestral to *Daubentonia*.
3. If primate but not near *Daubentonia*, whether it shows special relationship to any other major group, with special reference to the tarsioids and lemuroids.

Anticipating the conclusions reached below, on present evidence I believe:

1. That *Plesiadapis* is definitely to be classed as a primate.
2. That it shows no valid evidence of any special relationship to *Daubentonia*.
3. That it does show strong evidence of relationship to the tupaoids on one hand and the lemuroids (adapids and Malagasy lemurs) on the other, evidence most reasonably interpreted by considering *Plesiadapis* a derivative of the lemur ancestry not long after its divergence from that of the tupaoids. It is a sterile branch not more closely related to any known later primates.

In considering these problems, comparison has been made especially with *Tupaia* (also *Ptilocercus*), *Lemur* (and other lemurids, especially *Myoxicebus*), *Loris*, *Nycticebus*, and some other non-Malagasy primitive primates, *Notharctus*, *Tarsius*, and *Daubentonia*. Other genera were also compared, but these adequately represent the groups necessary to consider and serve to present the evidence. Explicit comparison with platyrrhines and catarrhines proved to be unnecessary after a preliminary trial,

¹I. e., "*Menotyphla*" in his text, but the group *Menotyphla* is now believed to be unnatural in this sense and is not based on *Tupaia* and its true allies, with which Gregory's comparison is primarily made.

²The view of Schlosser (later abandoned) and of Forsyth Major that *Plesiadapis* is a rodent seems so manifestly controverted by its whole structure and has been so adequately discussed by Stehlin as to require no further notice.

as these more advanced forms show no especial resemblance to *Plesiadapis* not also shown by lemuroids.

The question of primate or insectivore relationships has become one purely of primate or tupaoid affinities, as there is no question of close resemblance to any insectivores other than the tupaoids.¹ Since the tupaoids are now universally recognized as a conservative offshoot of the primate ancestry, the plesiadapids are related to the primates in either case, and the question as to their inclusion in that order or in a protoprimate division of the Insectivora is in part purely verbal. In fact it ceases to exist at all if Le Gros Clark (1934) is followed in placing the tupaoids in the Primates, and his evidence is so detailed, so carefully evaluated, and so convincing that I see no reasonable alternative to such a course. If the tupaoids are primates, then the plesiadapids are necessarily primates also. The essential point, however, as to whether they are closer to tupaoids or to some other group among the primates, remains.

The evidence of the dentition has not been very fully analyzed. Most students have called it vaguely "lemuroid." Stehlin (1916) emphasized the *Daubentonia*-like enlargement of the incisors, but he noted that these are functionally quite different from those of *Daubentonia*, with which they could only be linked by intermediate forms testifying to the reality of the profound changes involved. Such intermediate forms he thought recognizable in *Chiromyoides* and *Heterohyus* (*Amphi-chiromys*, *Heterochiromys*). But later discovery and research (culminating and summed up in Jepsen, 1934) have clearly shown that *Chiromyoides* is barely separable from *Plesiadapis* and makes only the most distant and superficial approach to *Heterohyus*, while the structural ancestry of *Heterohyus* can be traced back to *Labidolemur*, which is contemporary with *Plesiadapis* and even at that early date clearly belongs to quite a different line of development. As regards the cheek teeth, those of *Daubentonia* are so degenerate that they show little more than that they were probably derived from a tuberculosectorial type. As all Eocene and Paleocene primates (and most other earliest Tertiary mammals) are of this type, the positive evidence is wholly inconclusive. Stehlin points out that they could be derived from *Plesiadapis*, but this is negative evidence of no particular value. They could about equally well be derived from any other Paleocene or Eocene primate, or for that matter from any one of many insectivores, rodents, carnivores, or even ungulates, as far as this evidence goes.

¹Matthew (1917) pointed out certain analogies to soricoids in the dentition, but did so only descriptively. He never maintained that any special soricoid relationship is indicated.

Stehlin's argument may perhaps be summed up as being that *Daubentonia* must somewhere on earth have had as a basal Tertiary ancestor a primate with enlarged incisors, that *Plesiadapis* is a basal Tertiary primate with enlarged incisors, and that therefore *Plesiadapis* is or may be the ancestor of *Daubentonia*.¹ Every point is, however, dubious in the extreme. It is possible, but conjectural, that *Daubentonia*'s enlarged incisors date from the Paleocene. Nothing is known of the date of origin or rate of acceleration of this character. Such characters can be developed rapidly. Analogy with rodents does not appear to have much bearing and even they probably developed rootless incisors rapidly. Although this occurred in them before the Eocene, it may have occurred in *Daubentonia* at the same rate but at a different time, the Pliocene for instance. Nothing is actually known as to this. On the second point, *Plesiadapis* is not the only early primate with enlarged incisors. These developed at least six times in the Paleocene and Eocene. *Tetonius*, *Necrolemur*, *Carpolestes*, *Labidolemur*, *Phenacolemur*, and *Plesiadapis* (and allied genera in each case) represent different lines of descent in each of which enlarged front teeth apparently developed independently. As the lines are divergent, it is unreasonable to suppose that more than one of them is related to *Daubentonia*. It is, furthermore, unnecessary and in fact impossible to assume a priori that any of them is related to *Daubentonia*, the early Tertiary history of which is quite as likely to be unknown as is its later history. A conclusion cannot be reached with any probability except on better evidence than mere enlargement of anterior teeth, an adaptive character which has appeared over and over again in many different groups of mammals.

As regards molar pattern, *Plesiadapis* resembles the primitive Notharctinae more closely than any other group. The resemblance to the Adapinae is more distant, but still striking in many respects. There is also considerable resemblance to *Necrolemur*, a later tarsiod, and to *Paromomys*, a Middle Paleocene genus of doubtful position perhaps tarsiod. Resemblance to the other main groups of early primates is more distant.

The resemblance to *Pelycodus*, most primitive known notharctine, is really amazing and extends to the apparently most insignificant details. The upper molars are of almost identical structure throughout, differing only in details of the cingula and proportions such as may characterize species of one genus. In the lower molars, *Pelycodus* has the

¹ It is impossible and unnecessary to repeat the argument in full, but it is perhaps unjust to abbreviate it without adding that Stehlin's views are presented logically and with proper caution and that his whole discussion, even though in part superseded by later discovery, marked a great stride forward.

paraconids slightly more distinct, but the resemblance is equally striking and includes even such features as the minute grooving of the trigonid face of the metaconid and the exact structure of the complex grooving of the talonid face of the hypoconid and of the whole heel of M_3 . Matthew and others have noted this resemblance, although hardly recognizing its very complete character, but have tended to distrust or even reject it because of the well-known fact that early tuberculosectorial dentitions are all more or less alike and that erroneous allocations have frequently resulted from comparisons of molar teeth alone. This, is, of course, true, but it is also true, as Gidley pointed out, that such complete convergence in a really complicated pattern as occurs between *Plesiadapis* and *Pelycodus* has rarely or never been found in mammals not truly related, and that the characteristic structure of *Plesiadapis* molars is encountered in no order other than the Primates. The evidence of molar pattern is decidedly in favor of rather close relationship to the Notharctinae. As this happens to be correlated with other resemblances to that subfamily or, more broadly, to the general division of primates which it represents, there is every reason to accept this evidence as valid.

P_{3-4}^{3-4} are decidedly less notharctine. P^3-4 are variable in both groups, and may be closely similar. The most obvious difference in some species of *Plesiadapis* is the large conule, but this is reduced or absent in the more advanced species of *Plesiadapis* and in its close ally *Platychoerops* (that is, in the forms actually contemporaneous with the notharctines available for comparison). P_{3-4} show that the two groups are divergent (which is obvious in any event) but offer no evidence for or against relationship. In *Plesiadapis* these teeth are relatively short and broad, in *Pelycodus* generally more slender. The trigonid is more highly differentiated in *Pelycodus*, but this is a progressive character approached by the more advanced plesiadapids.

The anterior teeth are, of course, very unlike in the two groups. The very doubtful suggestion of possible tarsiod affinities in the dentition consisting of a resemblance (much less exact than to the Notharctinae) in the posterior teeth to a few advanced and aberrant later fossil tarsiods and to some doubtfully placed early genera, is negated by the known skeletal characters. In all the characters in which *Tarsius* differs from the lemuroids and which are known in *Plesiadapis*, the latter is nearer the lemuroids. Nor does it show any of the definite, but in some cases rudimentary, tarsiod developments also to be seen in only slightly later fossil tarsiods. It is hardly possible that the plesiadapids have any closer

relationship to the tarsoids than implied in the statement that both are primitive primates.

A similar conclusion seems to be even more strikingly, and rather surprisingly, true as regards *Daubentonia*. I am unable to find any characteristic daubentoniid character, even in the most rudimentary form, in any known part of *Plesiadapis* beyond the enlarged incisors, which are not really very similar and have little or no value as evidence, as pointed out above. If the ancestry of *Daubentonia* really had already begun to diverge in the Paleocene and was already characterized by enlarged incisors, it is reasonable to suppose that it would also have some other daubentoniid characters, among the many which appear in the whole skeletal structure, but *Plesiadapis* has none. If, as is also possible, *Daubentonia* is really a more modern offshoot of the general lemurid stock, this would necessarily imply that its early Tertiary lemurid ancestry was more generalized than is *Plesiadapis*. In short, there is no evidence that *Plesiadapis* is related to *Daubentonia*, there is much evidence that it is not so related, and this view can no longer be maintained.

It is still possible that *Daubentonia* is related to the Apatemyidae, although the evidence is very inadequate and not very convincing. The question is foreign to the present discussion.

Plesiadapis does show numerous and striking resemblances to three groups: Adapidae, Tupaiidae, and Lemuridae. Special relationship with all three is entirely possible. Gregory¹ (1920) has conclusively shown that the adapids are a primitive offshoot of the lemuroid ancestry. Le Gros Clark (1934) has similarly demonstrated that the tupaoids are a still more primitive, more persistent, but more conservative offshoot of the same stock. The dentition is aberrant in the diprotodont habitus, notharctine in molar structure, apparently somewhat less lemurid and much more notharctine than tupaoid.

The skeletal characteristics, explicitly brought out in the comparative description above, may be summarized as follows:

1. Most of the many characters shared by tupaoids and lemuroids are also present in *Plesiadapis*. These characters define the whole tupaoid-notharctine-lemurid line, and show that *Plesiadapis* is a member or a derivative of this series.

¹ Gidley (1923) very sharply attacked Gregory's conclusion. His arguments are principally (a) that the Adapidae (or Notharctinae) are not lemuroids because they resemble only the Malagasy, not the African and Asiatic "lemurs," and (b) that they are platyrrhines because they resemble that group in many characters. Both these points were even more fully brought out by Gregory and were, it would seem, more logically interpreted by him. The first suggests that the Adapidae and Malagasy lemurs belong to a natural group from which the loriforms are excluded, which is the conclusion reached by Gregory long before. The second suggests that the Adapidae, or Notharctinae, stand near the platyrrhine ancestry, which was also Gregory's conclusion. Whether they be considered as preplatyrrhine lemuroids (Gregory) or as lemuroid platyrrhines (Gidley) does not really seem to be as important or as different as Gidley suggests, but the former seems somewhat more in accord with the evidence and more conducive to a broad view of relationships.

2. In many characters *Plesiadapis* is definitely closer to the notharctines, lemuriids, or both than to the tupaioids. Individual characters of this sort are not very conclusive, but so many are found, in almost all parts of the skeleton, that it seems highly probable that they are significant. They show that the plesiadapids branched off from the lemurid stock after the separation of the more primitive tupaioids.

3. There are a few characters in which *Plesiadapis* resembles the tupaioids rather than the lemuriids, and more (but still fewer than in the second category) in which it is approximately intermediate between the tupaioids and lemuriids. As far as can be judged, these are without exception characters in which the tupaioids are archetypal to the lemuriids, and they therefore suggest merely that when the plesiadapids arose from it the lemurid ancestry still retained certain primitive features which were lost in later forms.

4. There are one or two characters in which *Plesiadapis* resembles the loriforms more than the lemuriiforms but these are so few, the resemblance is so inexact, and the characters are so unimportant and easily convergent in nature that they can hardly indicate any special relationship. The plesiadapid structure is lemuriiform, and not loriform, throughout.

5. *Plesiadapis* has several specifically notharctine characters, especially in the molar pattern but also a few in the skeleton. It also has a few specifically lemurid characters, or characters of the general lemuroid ancestry retained in lemuriids and lost in notharctines. The suggestion is that the plesiadapids arose from the primitive lemuroid ancestry at about the same time as the notharctines and probably from the same subdivision or general stock as the latter. They can hardly, however, have arisen from a differentiated and specifically notharctine ancestry.

6. There are numerous characters in which *Plesiadapis* is divergent from all the other groups mentioned. These are the characters of the plesiadapid line as such and are in general adaptive habitus characters, not wholly concealing more basic resemblances. They show that the plesiadapids were an early side line, specialized in its own way, not ancestral to any known forms.

The following suggested new classification of the Suborder Lemuroidea involves the conclusions of the present study, and also a detailed review of the whole subject, with special reference to the recent work of Le Gros Clark (summed up in 1934).¹

The form and the abbreviations are as in my general classification of mammals (1931), and this may be taken as superceding the classification of the same suborder on page 271 of that paper.

1. Suborder LEMUROIDEA Mivart, 1864.

Infraorder LEMURIFORMES Gregory, 1915.

Superfamily Tupaioidea

†Fam. Anagalidae Simpson, 1931. Olig.; As.

Fam. Tupaiidae Mivart, 1868 (Tupaina

Gray, 1825; Tupaiadae Bell, 1839). R.; As.

¹ I am personally indebted to Professor Le Gros Clark for additional comments and for examining this classification, for the imperfections of which, however, he is not responsible and which he has not seen since the Plesiadapidae were removed from the Daubentonioides and placed in the Superfamily Lemuroidea.

Superfamily Lemuroidea

†Fam. Plesiadapidae Trouessart, 1897. M.
Paleoc.-Eoc.; N.A., Eu.

†Fam. Adapidae Trouessart, 1879. [In-
cluding Notharctidae Trouessart, 1879].
Eoc.; Eu., N.A.

Fam. Lemuridae Gray, 1821. [Including
Megaladapidae Forsyth Major, 1893,
Nesopithecidae Forsyth Major, 1896.]
Pleist.-R.; Madagascar.

Fam. Indridae Burnett, 1828 (Indrisidae
Alston, 1878.) R.; Madagascar.

Superfamily Daubentoniioidea

Fam. Daubentoniidae Gray, 1870 (Dauben-
toniidae Gray, 1863 = Cheiromyidae Gray,
1821, invalid name). R.; Madagascar.

Infraorder LORISIFORMES Gregory, 1915.

Fam. Loridae Gray, 1821. ?Plioc.-R.; S. As.
R.; S. As.

Fam. Galaginidae Alston, 1878 (Galagonina
Gray, 1825). R.; Af.

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THE TIFFANY FAUNA, UPPER PALEOCENE

III.—PRIMATES, CARNIVORA, CONDYLARTHRA, AND AMBLYPODA

BY GEORGE GAYLORD SIMPSON

In the first section of this revision, which exigencies of publication have caused to appear as three separate papers, the Tiffany fauna as a whole and its occurrence were reviewed, and the multituberculates, marsupials, insectivores, and a possible bat described. The second section was devoted to the morphology and relationships of *Plesiadapis*, omitting detailed taxonomy. The present paper is the last of this series. It begins with the taxonomy of the Tiffany *Plesiadapis* and completes the review of the fauna.

PRIMATES

PLESIADAPIDAE

PLESIADAPIS Gervais, 1877

SYNONYM.—*Nothodectes* Matthew, 1915.

Matthew (1915) based *Nothodectes* on a single fragmentary lower jaw. This did not show any of the striking characters of the *Plesiadapis* group, and comparison with *Plesiadapis* was then possible only through the very inadequate figures of Lemoine, so that the resemblance was not recognized. The discovery of the fine Tiffany material and the publication of better, but still incomplete, figures of the Cernaysian form by Stehlin (1916), led Matthew to recognize the very close resemblance between *Nothodectes* and *Plesiadapis*, and he wrote (1917, p. 832) of the former that "the generic characters do not separate it satisfactorily from *Plesiadapis* as described and figured by Lemoine, but pending a revision of Lemoine's genus it seems better to retain *Nothodectes* provisionally," and he elsewhere noted the possibility that the genera are identical. The principal characters used to distinguish *Nothodectes* provisionally were:

Upper incisors more elongate and with three, not two, apical cusps.

P⁴ with paracone and metacone more separate than usual in *Plesiadapis*.

Upper molars a little less quadrate, with weaker hypocone and external cingulum.

Paraconid less distinct on the lower molars and entoconid shelf of M_3 narrower and more of the normal crested type.

The implication was that these are not primarily generic characters but that they were distinctions indicated by the incomplete evidence available which prevented the assumption of generic identity in the characters not then published for the European species. Teilhard (1921) made the awaited thorough revision of the latter forms and showed that the early species (i.e., those truly of *Plesiadapis* and not of *Platychoerops* in my still more recent usage) do have three lobes on the upper incisor, separate paracone and metacone on P^4 , and paraconids much as in *Nothodectes*.¹ He did not specifically mention other points made by Matthew,² but as no other distinctions were found, he followed the course indicated by Matthew in such a case and united the genera under the older name, *Plesiadapis*. There can hardly be any question as to the correctness of this synonymy, and it is now generally accepted.

Teilhard also showed that the old generic names *Platychoerops* Charlesworth, 1854, and *Miolophus* Owen, 1865, which are absolute synonyms, refer to an animal closely related to *Plesiadapis* Gervais, 1877. Teilhard considered all three as synonymous,³ but pointed out that their type species do have very marked distinctions. In 1929 I tabulated these distinctions, pointed out that they are surely of generic rank by ordinary standards, and so accepted both *Platychoerops* and *Plesiadapis* as valid and different genera.⁴

In describing *Plesiadapis cookei*, Jepsen (1930, pp. 525^a-528) pointed out that it has two characters of *Platychoerops*, the stronger mesostyles and lack of conule on P^4 , but otherwise is closer to *Plesiadapis*, and he therefore here and in his later paper (1934) follows Teilhard and makes *Platychoerops* and *Plesiadapis* synonyms. Much discussion is not called for here, but continued use of the name *Plesiadapis* must be explained. Genera are based essentially if not entirely on their genotypes, which are species, in this case *Platychoerops richardsonii* and *Plesiadapis tricuspi-*

¹ Matthew noted that they are separate in some European forms. The separation, better in *Plesiadapis gildleyi* than in *Plesiadapis tricuspidens*, still appears to be a valid character, but of only specific value.

² He states that Matthew also distinguished the genera by the absence of a paraconid in *Nothodectes*, but as far as I find Matthew did not give a generic difference in quite this form. It was, as regards the exact point mentioned, a morphological interpretation equally applicable to American and to European forms.

³ In spite of its being doubly antedated, if this synonymy be accepted, Teilhard continues to call the genus *Plesiadapis*, and Jepsen follows him. This is, of course, invalid.

⁴ Jepsen's note (1934, p. 290, footnote 3) might give the impression (not intended by the author) that the genera were separated artificially on the basis of their age in order to preserve *Plesiadapis* from synonymy. They were, in fact, defined by me on numerous definite and specified morphological characters in which the genotypes differ. The difference in age merely gives the then known geological distinction of these natural units, and is not the means of distinguishing them, and the preservation of the name *Plesiadapis* is purely incidental.

⁵ On page 525 *Plesiadapis* is inadvertently labeled as a new genus.

dens. To demonstrate their synonymy, it must be held that the differences between these species are of less than generic value. The presence of marginal species, sometimes even difficult to place as to genus, is very common. In ancestral and descendant genera it is not only the rule, but with increasing knowledge is also absolutely inevitable that intermediate species will show gradations between the genera. This fact in itself obviously cannot in any way lessen the distinctiveness of the genotypes and if the latter are, on the whole, so distinct as to warrant generic separation they remain so, no matter how many intermediate structural stages may be found. To maintain any other view would eventuate in considering *Hyracotherium* as synonymous with *Equus*. New discoveries may permit better definition, as they do in this case by showing that the conule of P^4 should not be considered as a generic character of *Plesiadapis*, but even if all the characters of earlier definitions are intermingled in a species this does not in itself make the genera synonymous. In this case such a transition has not been found, although it might well be. Of the seven characters given as distinguishing *Platychoerops* and *Plesiadapis*, which still seem to me of decisive generic value, *Plesiadapis cookei* is like *Platychoerops* in one or two, and otherwise is like *Plesiadapis*. The genera seem to me to be surely distinct, on the most commonly current criteria.¹

Plesiadapis gidleyi is by far the best known animal of the Tiffany fauna, and of its family, being represented by the whole dentition and many skeletal parts. The morphological description and discussion of affinities have been given separately in the previous paper of this series.

Plesiadapis gidleyi (Matthew, 1917)

Nothodectes gidleyi, MATTHEW, 1917, p. 832.

TYPE.—Amer. Mus. No. 17170, upper and lower jaws with most of the dentition.

PARATYPES.—Amer. Mus. No. 17171, palate with dentition complete save left P^2 .

Amer. Mus. No. 17172, lower jaws with incisors, left P_3 and M_{2-3} , and right M_{1-2} , with parts of maxillae, some upper teeth, and unimportant skeletal fragments.

IMPORTANT REFERRED SPECIMENS.—Amer. Mus. No. 17389, left lower jaw with very little worn dentition, lacking only P_2 .

Amer. Mus. No. 17372, associated upper and lower milk teeth and first molars.

Amer. Mus. No. 17173, crushed palate with most of cheek teeth.

Amer. Mus. No. 17174, left lower jaw with most of teeth.

Amer. Mus. No. 17200, lower jaws and associated right maxilla, with teeth.

¹ I am strengthened in my belief that this criterion (as to how great a distinction must be to have generic value) is in accordance with current opinion by such cases as the separation of *Parectypodus* from *Ectypodus*, *Plesiolestes* from *Palaechthon*, *Teilhardella* from *Eochiromys*, in which Jensen has established a standard which I accept and by which *Platychoerops* cannot possibly be united with *Plesiadapis*. In further application of such a criterion he recognizes *Chiromyoides*, which is almost certainly closer to *Plesiadapis* than is *Platychoerops*.

Amer. Mus. No. 17388, skull, badly crushed and mixed, with most of cheek dentition, associated with imperfect lower jaws and some skeletal fragments.

Amer. Mus. No. 17379, lower jaws associated with much of skeleton.

HORIZON AND LOCALITY.—Mason Pocket,¹ Tiffany Beds, Colorado.

DIAGNOSIS.—Basal cuspule of lower incisor distinct. P_2 vestigial but apparently always present. P_4 relatively short and wide, no metaconid. Talonids of M_{1-2} considerably wider than trigonids. Hypostylids present on all molars, strong on M_1 . Enlarged upper incisor with three apical cusps. Paracone and metacone distinct on P^3 and well separated on P^4 . Hypocone region of M^{1-3} without a distinct cusp. Posterointernal part of M^3 widely expanded and basined. Molar mesostyles moderate. Length M_{1-2} (mean of six specimens) 10.5 mm. Other measurements given below.

In uniting the genera *Plesiadapis* and *Nothodectes*, Teilhard (1921), p. 24, added, "Je suis donc convaincu qu'une comparaison directe des deux formes démontrerait l'identité, non seulement générique, mais spécifique, de *Ples. tricuspidens* et *Noth. Gidleyi*." Abel (1931, p. 264 and elsewhere) took this prophecy as an accomplished fact, recorded *Plesiadapis tricuspidens* Gervais in the Tiffany, and even reproduced Matthew's figures over this name. With due respect for the synthetic spirit of revision and sympathy with the principle of making taxonomic groups as broad as the facts reasonably allow, in this case it is going too far to suppose that the plesiadapid of southwestern Colorado is exactly the same as its approximately contemporaneous relative of northeastern France. It is rather surprising to find a genus common to the two faunas (generic identity of their animals not being established or probable in any other case), but this is almost certainly correct. The species, however, are very distinct, and not on a priori grounds but on their morphological characters.

The Cernaysian plesiadapids are much larger animals, in the first place. The largest of them are twice the size of *P. gidleyi* and even the specimen figured by Teilhard to show the small extreme in variation (1921, Pl. I, fig. 5) is one-third larger than the largest specimen of *P. gidleyi*.² The very decided difference in mean size, without any overlapping of the size distributions, associated with the widely different proveniences, is in itself a valid specific distinction. In addition there are numerous minor morphological distinctions and while some of these might prove invalid if the original specimens could be compared, it is improbable that they are all illusory. None of the many specimens of *P. gidleyi* has a metaconid on P_4 , and the presence of this cusp is given as

¹ One specimen, a single tooth, was found near but not in the Mason Pocket.

² I have been unable to find very adequate exact measurements of *T. tricuspidens*, but see below.

typifying *P. tricuspidens* by Teilhard and it is well shown in his figures. *P. tricuspidens* does not appear to have hypostylids, although perhaps they are present and unnoted. Although in *P. tricuspidens* the outer cusp of P^4 has been shown by Teilhard to be divided, nevertheless all the figures and descriptions (including Teilhard's) clearly indicate that the separation is more advanced in *P. gidleyi*. The hypocone of M^{1-2} seems to be a definite cuspule in *P. tricuspidens*, but it is not in *P. gidleyi*, and the posterointernal basin of M^3 seems to be more definite and expanded in the latter. Doubtless some of the numerous other minor and less obvious differences suggested by the published data would be confirmed by direct comparison. The species are surely closely related, but they are even more surely not identical.

P. dubius (Matthew), the first named American species, differs from *P. gidleyi* chiefly in the absence of P_2 , longer and more quadrate P_{3-4} , distinct paraconid and metaconid on P_4 , and nearly equal width of trigonid and talonid on M_{1-2} . *P. fodinatus* Jepsen also lacks P_2 , is said to have a weaker basal cuspule on the lower incisor than in *P. gidleyi*, has relatively narrower P_4 to M_3 than in *P. gidleyi*, lacks the metaconid of P_4 as in that species, and apparently has the trigonid-talonid proportions of M_{1-2} as in *P. dubius*.¹ In the upper teeth, the protoconule appears to be smaller on P^{3-4} , the hypocone more definite on M^2 , and the posterointernal expansion of M^3 less in *P. fodinatus* than in *P. gidleyi* but the teeth are closely similar. *P. fodinatus* is slightly but significantly larger than typical *P. gidleyi* or *P. dubius*.

P. cookei Jepsen likewise lacks P_2 and has a simple P_4 as in *P. gidleyi* and, also as in *P. fodinatus*, its lower cheek teeth are less expanded laterally than in *P. gidleyi*. The basal cusp of the lower incisor is lacking. P^4 has paracone and metacone poorly differentiated and lacks the protoconule, a character unique among known species of *Plesiadapis* and suggestive of *Platychoerops*, although the other characters are those of *Plesiadapis*. The upper molars apparently very closely resemble those of *P. gidleyi* except that the inner border of M^1 may be narrower and more rounded. The species is much larger than *P. gidleyi*.

The following table gives the important statistical data on lower teeth of *P. gidleyi*. As all the specimens included are from the Mason Pocket, the sample is probably very homogeneous as to race, but sex and age groups cannot be differentiated. Standard (not Probable) Errors are given:

¹ I take certain striking apparent differences in the contour of M_3 of the figure (Jepsen, 1930, Pl. v, fig. 6) to be due to the combination of a left M_3 with right P_4 to M_1 or to M_2 .

VARI- ATE	No. OF INDI- VIDU- ALS	OBSERVED RANGE	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
L P ₃	11	2.0-2.4	2.20 \pm 0.03	0.11 \pm 0.02	5.1 \pm 1.1
W P ₃	11	1.7-2.0	1.77 \pm 0.03	0.10 \pm 0.02	5.4 \pm 1.2
L P ₄	11	2.0-2.5	2.27 \pm 0.04	0.14 \pm 0.03	6.3 \pm 1.3
W P ₄	11	1.9-2.4	2.09 \pm 0.04	0.15 \pm 0.03	6.9 \pm 1.5
L M ₁	12	2.5-3.1	2.84 \pm 0.05	0.16 \pm 0.03	5.7 \pm 1.2
W M ₁	11	2.5-3.1	2.67 \pm 0.05	0.18 \pm 0.04	6.8 \pm 1.5
L M ₂	12	2.8-3.3	3.13 \pm 0.03	0.11 \pm 0.02	3.6 \pm 0.7
W M ₂	11	2.7-3.3	3.04 \pm 0.05	0.16 \pm 0.03	5.3 \pm 1.1
L M ₃	11	4.4-4.8	4.63 \pm 0.04	0.12 \pm 0.03	2.7 \pm 0.6
W M ₃	8	2.7-3.1	2.87 \pm 0.05	0.13 \pm 0.03	4.5 \pm 1.1

The figures in the following table are the deviation of the particular measurement in the species named from the mean of that measurement in *P. gidleyi*, divided by the standard deviation of the latter. The resulting figure gives a criterion of the significance of the deviation. If this figure is greater than two it is probable and if greater than three it is almost certain that the species differ significantly in this dimension. Significant figures are in bold-face. (Table on p. 7.)

P. gidleyi and *P. dubius* are not distinguishable in size, although they are morphologically. The figures for *P. fodinatus* and *P. cookei* are calculated from Jepsen's published raw data (1930) and show that both species are certainly distinct from *P. gidleyi*. Published measurements of the Cernaysian specimens are extremely scanty. These figures are from raw data published by Lemoine (1878) on a specimen referred to *P. tricuspidens* and the type of *P. recticuspidens*, the latter the smallest Cernaysian specimen (and hence nearest to *P. gidleyi*) that I find recorded in the literature. It is poorly preserved, and the molar widths may have been rather greater than indicated by Lemoine. In any event, it is clear that neither specimen can be conspecific with *P. gidleyi*, even on the basis of size alone. Incidentally, if the variability of *P. tricuspidens* was comparable with that of *P. gidleyi*, the most reason-

Variate	<i>P. dubius</i>	<i>P. fodinatus</i>	<i>P. cookei</i>	<i>P. tri- cuspidens</i>	<i>P. recti- cuspidens</i>
L P ₃	...	...	+21.8	....	....
W P ₃	...	...	+18.3	....	....
L P ₄	+0.9	...	+16.6	+26.6	....
W P ₄	+0.1	...	+14.1	+16.1	....
L M ₁	+0.4	+5.4	....	....	....
W M ₁	-0.9	+1.8	....	....	....
L M ₂	+0.6	+5.2	+26.1	+35.2	+11.5
W M ₂	-0.9	+1.6	+15.4	+9.1	-3.4
L M ₃	...	+7.2	+39.7	+21.4	+1.4
W M ₃	+1.0	+2.5	+12.5	+10.2	+1.0

able assumption, Teilhard cannot be correct in thinking that only one species is present in the Cernaysian, and there must be at least three species and possibly four, as Lemoine thought.

APATEMYIDAE

This family, founded by Matthew (in 1909) but later united by him and by most other students with the Plesiadapidae, has recently been revised and redefined by Jepsen (1934) who has clearly pointed out its many distinctions from the Plesiadapidae. About all the two groups have in common is a basically primate molar structure combined with a diprotodont habitus. The earliest known apatemyid is *Labidolemur*, which was first discovered in the Tiffany fauna but which is now somewhat more satisfactorily known from *L. kayi* Simpson of the Bear Creek, a Tiffany equivalent.

LABIDOLEMUR MATTHEW AND GRANGER, 1921

TYPE.—*L. soricoides* Matthew and Granger.

DISTRIBUTION.—Tiffany and Bear Creek, Colorado and Montana.

DIAGNOSIS.—A typical but primitive apatemyid. Dental formula not determinable but probably $\overline{1.0.2.3}$. Crown of enlarged incisor fully enamel covered, and enamel not extending into alveolus (in adult), superolateral edge of crown sharp and crenulated. P₄ with one (*L. kayi*) or two (probably in *L. soricoides*) roots, but in

¹ Much emended after Matthew and Granger, on the basis of subsequent discoveries of related forms and clearer recognition of affinities.

either case less reduced relative to the molars than in later genera. Trigonid of M_1 as wide as talonid and also of about equal length. Talonid of M_1 short and wide, nearly equal to trigonid, no distinct hypoconulid projection or third lobe (*L. kayi*). Mandible relatively slender and elongate for a member of this family.

Aside from its possession of the family characters, fully pointed out by Jepsen, it is very difficult to define this genus adequately, and the real distinctions from it of the more recently named genera *Eochiromys* Teilhard and *Teilhardella* Jepsen are not clear, although there is every reason to suppose that these genera are distinct.

The type material includes only the incisor and M_1 in the jaw, with a separate tooth, possibly P_3 , of doubtful association. The latter tooth, apparently found in matrix with the type, is one-rooted and strongly proclivous, but otherwise is not very like P_3 in later genera, as it does not bend down anteriorly and rises to a definite anterior cusp, with anterior and posterior crests, followed by a non-cuspidate heel. There is a strong internal cingulum.

Matthew and Granger doubtfully referred two specimens including M_2 and M_3 , but as already pointed out by Jepsen (1934, p. 289), these probably belong to *Ignacius* or *Phenacolemur* and not to *Labidolemur*. They are quite unlike the homologous teeth of *L. kayi*. See also below, *Ignacius*.

***Labidolemur soricoides* Matthew and Granger, 1921**

TYPE.—Amer. Mus. No. 17400, associated right and left lower jaws with incisor and M_1 of each side and doubtfully associated left ? P_3 .

HORIZON AND LOCALITY.—Mason Pocket, Tiffany Beds, Colorado.

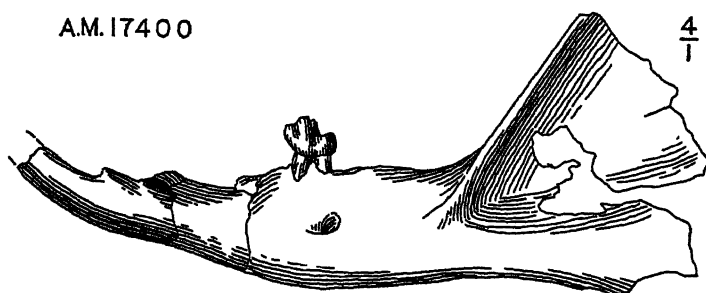


Fig. 1. *Labidolemur soricoides*. Type, Amer. Mus. No. 17400, left lower jaw with incisor and M_1 . External view. Four times natural size.

DIAGNOSIS.—Paraconid and anteroexternal cusp of M_1 relatively small, indistinct, and crested. Horizontal ramus slender. Measurements of type as below.

M_{1-3} (approximate, from alveoli of M_{2-3} and crown M_1) 5.5 mm.

M_1 length 1.7, width 1.1 mm.

CARPOLESTIDAE, NEW FAMILY

TYPE.—*Carpolestes* Simpson.

DISTRIBUTION.—Fort Union (Lower Lebo: Torrejon equivalent; "Princeton Quarry Level," Park County, Wyoming: Tiffany equivalent; Bear Creek Beds: Tiffany equivalent) and Tiffany.

DIAGNOSIS.—One enlarged lower incisor, its root not reaching the posterior end of P_4 . Intermediate teeth reduced in size and number and becoming one-rooted, button-like vestiges. P_4 much enlarged, with high trenchant blade on which a longitudinal series of cusps or serrations is developed, heel short and simple and becoming merged with the blade. M_1 with long open trigonid, paraconid distinct and anterior to protoconid. M_{2-3} of plesiadapid or, in less detail, primitive tarsioid type. P^{3-4} becoming large teeth with three longitudinal rows of cusps, the external row longest and cusps most numerous. Upper molars simple, of primitive tritubercular structure with small but distinct basal hypocone in *Carpolestes*.

The structural series *Elphidotarsius-Carpodaptes-Carpolestes* forms a natural group apparently quite as clearly defined and distinctive as that of the Plesiadapidae and Apatemyidae in Jepsen's redefinitions (1934), and may thus conveniently be regarded as a third family of somewhat analogous adaptive type. The presence of numerous resemblances between the plesiadapids, apatemyids, and carpolestids suggest that they might be separate phyla of a single stock, and hence more properly classified as subfamilies of one family, but this hypothesis must be discarded on present evidence. With few or no exceptions, the resemblances are: (a) shared equally by many other early mammals, hence merely primitive; or (b) shared equally by various early primates, hence evidence of primate relationships and not of relationships between the phyla as such; or (c) shared by numerous possibly related or clearly unrelated groups, as is true of the enlarged incisors, and hence to be considered as purely adaptive characters with no clear significance as to affinities. On the other hand there are important differences that suggest that they may not be derivatives from the same stock at all. For instance, in spite of the many resemblances between plesiadapids and carpolestids, their upper molars differ quite as much (and in analogous ways) as do those of animals belonging to quite different primary subdivisions of the primates, or even quite unrelated ordinally.

The Tiffany fauna contains the middle term of the structural series

represented by the three known genera of this family. *Carpolestes*, which is the most specialized genus and hence is chosen as type of the group, is from beds of nearly the same age in Montana and Wyoming. It differs little from *Carpodaptes*, and may be slightly later (although this seems improbable on other evidence) or belong to a moderately divergent and more progressive line. The most primitive carpolestid is *Elphidotarsius* from a Torrejon equivalent in the Crazy Mountain (Montana) Fort Union. It is decidedly different from the later forms, but in every respect its distinctions are purely primitive and it unquestionably belongs to this line. A more detailed consideration of the structure, evolution, and relationships of this family will be given in the course of a monograph of the Crazy Mountain Field and other work now in progress.

CARPODAPTES MATTHEW AND GRANGER, 1921

TYPE.—*C. aulacodon* Matthew and Granger.

DISTRIBUTION.—Tiffany, Colorado.

DIAGNOSIS.—Dental formula probably $\overline{1.1.3.3}$. ?Canine and P_2-3 reduced, with vertical, cylindrical roots and P_3 , at least, with globular, button-like crown. P_4 more enlarged than in *Elphidotarsius*, with four apical cuspsules or serrations, an obscure, lower anterior cuspule, and a single talonid cusp, well differentiated from the main blade and lower than the trigonid of M_1 . All these cuspsules in a straight anteroposterior line. Trigonid blade of M_1 slightly less elongate than in *Carpolestes*. Third lobe of M_2 relatively smaller, less projecting and less asymmetrical than in *Carpolestes*.

Matthew and Granger gave the dental formula as $\overline{7.1.4.3}$, assuming that the large tooth is a canine and that other teeth might occur anterior to it. Jepsen's specimen of *Carpolestes dubius* (Jepsen 1930) showed that this is in fact the most anterior tooth, and he identified it as possibly an incisor, giving the formula (with a query) as $\overline{1.0.4.3}$. That the enlarged tooth is an incisor, as Jepsen thought, seems highly probable. It is impossible to determine whether the following tooth is a canine or P_1 , but from analogy with the most similar forms it seems slightly more probable that it is the canine, and in any event this legitimate, but purely hypothetical, assumption facilitates comparison with other groups. The formulae of *Carpodaptes* and *Carpolestes* were apparently identical.

The anterior alveolus is so imperfectly preserved in the present specimen that its character is not very clear. In comparison with the better

¹ Modified after Matthew and Granger, for distinction from *Elphidotarsius* and *Carpolestes*, neither of which was known when they wrote.

known *Carpolestes*, especially *Carpolestes dubius* Jepsen, the incisor seems to be slightly less procumbent in *Carpodaptes* and its root to terminate slightly more anteriorly, beneath P₃.

The molar crowns are higher than in *Carpolestes nigridentis*, but do not noticeably exceed *Carpolestes dubius* in this respect. The paraconids are distinct on all three molars, apparently a distinction from *Carpolestes dubius* but not from *Carpolestes aquilae* or *nigridentis*.

The structure throughout is closely similar to that of *Carpolestes*, which is much better known, and in the several points which validate the distinction of the genera *Carpodaptes* appears to be less specialized.

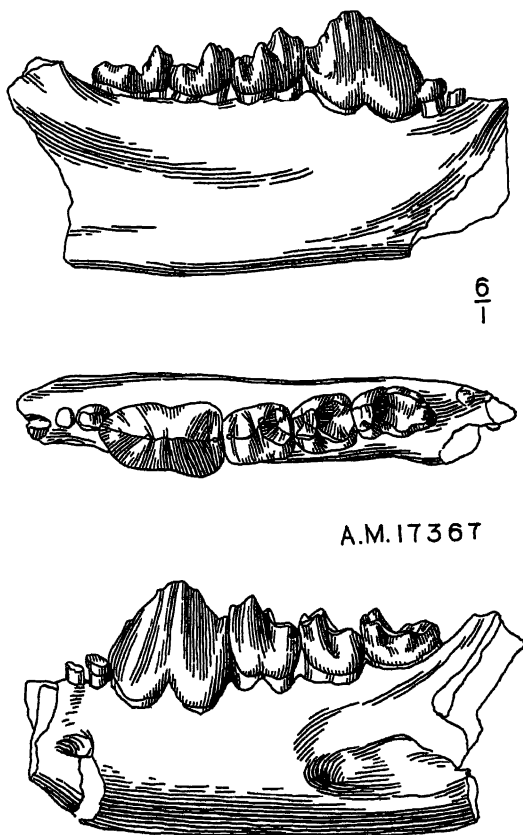


Fig. 2. *Carpodaptes aulacodon*. Type, Amer. Mus. No. 17367, left lower jaw with P₃-M₃. Internal, crown, and external views. Six times natural size.

Carpodaptes aulacodon Matthew and Granger, 1921

TYPE.—Amer. Mus. No. 17367, left lower jaw with P_3 – M_3 , roots of canine of P_3 , and fragment of incisor root.

HORIZON AND LOCALITY.—Mason Pocket, Tiffany Beds, Colorado.

DIAGNOSIS.—Sole known species of genus. Measurements of type below.

M_{1-3} : 4.7 mm.

P_4		M_1		M_2		M_3	
L	W	L	W	L	W	L	W
2 8	1 7	1 4	1 5	1 2	1 4	1 8	1.2

ANAPTOMORPHIDAE**NAVAJOVIUS** MATTHEW AND GRANGER, 1921

TYPE.—*N. kohlhaasae* Matthew and Granger.

DISTRIBUTION.—Tiffany, Colorado.

DIAGNOSIS.¹—Dental formula perhaps $\frac{2 \ 1.3.3}{1 \ 1.3.3}$ (but very doubtful, see below).

Enlarged lower incisor with long, straight, spatulate crown. Canine or P_2 erect, one-rooted, with large vertical blade and small heel. P_3 smaller, two-rooted, with similar but lower crown. P_4 large, stout, paraconid not indicated, metaconid barely visible as a rudiment, heel small, partly basined. Molar trigonids triangular in outline, but with anteroexternal angulation. Paraconids very small but distinct, internal. Protoconids and metaconids equal. Talonid basins wide and deep, hypoconulids distinct. M_3 reduced, no third lobe, hypoconulid single. P^4 preceded by three laterally compressed, two-rooted, trenchant teeth, decreasing in size from front to back. P^4 large, transverse, with low but well differentiated protocone, metacone absent or barely incipient. M^{1-2} transverse, of simple tritubercular type with rudimentary basal cingular hypocones, distinct conules, no mesostyle. M^3 reduced.

What appears to be the first lower tooth, presumably an incisor, is preserved separately but with a possible contact on the jaw and probably associated. It is large, although less so than the incisors of *Labidolemur* or *Phenacolemur*, straighter than in those genera, and laterally compressed but with a spatulate, excavated face directed upward and inward (medially) and bounded by sharp longitudinal crests. Matthew and Granger speak of it as being pointed. The tip is not now preserved. This was followed by a much smaller, slightly procumbent tooth with one root, the crown of which is not preserved. The next tooth is vertical,

¹ Somewhat modified after Matthew and Granger.

one-rooted, with a high, very slightly proclivous, blunt spatulate blade followed by a minute heel. It would be natural, from the lower jaw alone, to consider this as the canine, as Matthew and Granger did, but from an upper jaw (not included in their study and presumably not prepared when they wrote) it seems probable that this tooth occluded posterior to the anterior maxillary tooth. If this is correct, it can hardly be the canine, but must be P_2 , in spite of its enlargement relative to P_3 .

P_3 has two roots and is similar to the preceding tooth save for being much lower. P_4 is a large tooth, rising slightly above M_1 . The trigonid is plump and bears a very faint indication of an incipient metaconid. The low heel bears a small basin on the internal side, with two poorly distinguished posterior cusps.

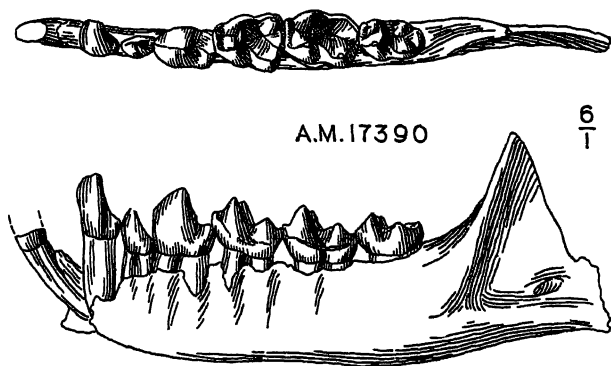


Fig. 3. *Navajovius kohlihaasae*. Type, Amer. Mus. No. 17390, left lower jaw with incisor and P_2 - M_3 . Crown and external views. Six times natural size.

The molar trigonids are of simple tuberculosectorial type with protoconid and metaconid equal and paraconid very small, anterointernal. The most characteristic modification is that the protoconid-paraconid crest is angulate at the anteroexternal corner of the crown (as in many early primates). The talonids of M_{1-2} are considerably larger than the trigonids and are broadly and deeply basined, with distinct and high hypoconulids in addition to the large, normal hypoconids and entoconids. There is a faint suggestion of twinning of the entoconids. There are moderate external cingula on the talonid of M_1 and talonid and trigonid of M_2 , but not on M_3 . M_3 is reduced and, although longer than M_{1-2}

relative to its width, has a small and simple heel without third lobe or duplicated cusps.

A specimen (Amer. Mus. No. 17399) evidently cleaned since Matthew and Granger wrote shows the maxillary teeth more completely than does the type. The most anterior tooth (it is not absolutely impossible but is in the highest degree improbable that there was another more anterior in the maxilla) is two-rooted, high, very strongly compressed laterally, and shearing. It has a sharp apex and a convex anterior and straight posterior edge. From its being two-rooted, one would suppose this to be a premolar, but two-rooted canines do occur among primitive mammals; and from its enlargement and general function, its forward position and occlusion apparently even anterior to the caniniform tooth of the lower jaw, and the fact that in the apparently most nearly related animals a premolar is almost invariably lost and the upper canine almost invariably retained, it seems more likely to be a canine.

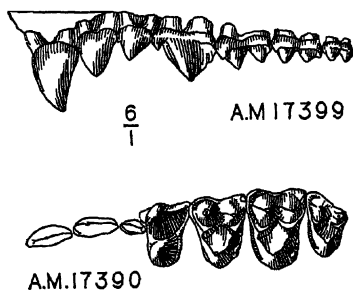


Fig. 4. *Navajovius kohlhaasae*. Amer. Mus. No. 17399, left maxilla with C and P²-M², external view, and the type, Amer. Mus. No. 17390, left P⁴-M², with canine and P²-³ supplied from the other specimen, crown view. Six times natural size.

The following two teeth, probably P²-³ in any case, are generally similar but are successively smaller and less compressed. P⁴ is nearly as large as M¹ and is fully transverse. The outer wall is high, pointed, and shearing, with small anterior and posterior styles. An incipient metacone may be indicated by a slight deflection of the posterior cutting edge, far from the apex. The protocone is fully distinct and nearly as large as on the molars, but lower relative to the great outer cusp. The posterior cingulum and posterior protocone crest are continuous and tend to form a very small posterointernal basin. There is no posterointernal

cingulum basal to this, and no hypocone. There is a very faint possible indication of a protoconule, but none of a metaconule.

M¹⁻² have paracone, metacone, and protocone about equal in height, small distinct subequal conules, and simple external cingulum all in the usual primitive relationships. There is an anterointernal basal cingulum, not forming a cusp, and a stronger posterointernal cingulum terminating at the inner end in a rudimentary basal cingular hypocone. There are indications of a very feeble ridge from the protocone to the hypocone. M³ is much reduced in all dimensions, and particularly in the metacone and posterior cingulum.

Matthew and Granger referred this peculiar little animal to the Tarsiidae, implying relationship to the Eocene anaptomorphids which they also placed in that family. This relationship seems most probable on present evidence, although not certain. P⁴ and the molars very closely resemble those of *Omomy*s and its allies, differing only in minor details of no probable supergeneric significance, but the odd specialization of the more anterior teeth is unlike any other known genus. As this general group in the Eocene is widely variable in its anterior teeth and runs to specializations of a similar, but not identical, nature, this is not strong evidence against relationship. The peculiar lower incisor (which, however, is not certainly associated) is especially striking, but in later anaptomorphids the enlargement of an incisor is common, and the crowns are not known for comparison.

***Navajovius kohlhaasae* Matthew and Granger, 1921**

TYPE.—Amer. Mus. No. 17390, upper and lower jaws, probably of one individual.

PRINCIPAL REFERRED SPECIMEN.—Amer. Mus. No. 17399, upper jaws with all maxillary teeth except left M²⁻³.

HORIZON AND LOCALITY.—Mason Pocket, Tiffany Beds, Colorado.

DIAGNOSIS.—Sole known species of genus. Measurements of type below.

M¹⁻³: 4.1 mm.

P ⁴		M ¹		M ²		M ³	
L	W	L	W	L	W	L	W
1.6	1.5	1.4	1.7	1.4	1.9	0.9	1.6

FAMILY UNCERTAIN

PHENACOLEMUR MATTHEW, 1915

SYNONYM.—*Ignacius* Matthew and Granger, 1921.

Phenacolemur was based on lower jaws from the Sand Coulee and Gray Bull, Lower Eocene, and upper jaw fragments of the same origin were doubtfully referred. *Ignacius* was based on an upper jaw, and *Labidolemur* was described at the same time from a lower jaw. The fragmentary nature of the last two types, with some of the more crucial diagnostic characters missing (as is shown by later discoveries), prevented their clear distinction from each other or from *Phenacolemur*, close resemblance to which was recognized. Jepsen (1934, p. 289) indicated a possible solution of the problem of these various fragmentary dentitions. They can now be sorted out with little possibility of error, and Jepsen's suggestions seem to be fully substantiated.

The attribution by Matthew of upper teeth from the Gray Bull to *Phenacolemur* seems to be beyond any serious question. They are perfectly harmonious with the lower teeth of that genus and occlude exactly with them. The repeated occurrence together of uppers and lowers of this type, here in the Tiffany as well, and the absence in every case of any other known lower teeth with which these characteristic uppers could belong make the association very convincing.

Sorting out the Tiffany specimens, there are four specimens with lower molars which are miniature counterparts of the Lower Eocene *Phenacolemur*. Two are associated with incisors, and two isolated incisors of the same type may thus be added to the group. The upper jaw on which *Ignacius* was based unquestionably belongs with these, not only on the basis of harmony and occlusion and the possibility of association with other known teeth in the collection, but also because the *Ignacius* upper teeth are, like the lowers, exactly like those of Gray Bull *Phenacolemur* in miniature. The two specimens which Matthew and Granger (1921) referred to *Ignacius*, Nos. 17377 and 17498, clearly belong here. The two which they doubtfully referred to *Labidolemur*, Nos. 17401 and 17405, also belong here, the association not having been recognized because of the absence of the characteristic incisors in these specimens and the fact that the teeth present, M_2 and M_3 , were unknown in the *Labidolemur* types and also absent in the jaws recognizable as of *Ignacius*.

Labidolemur was compared with *Phenacolemur* by Matthew and Granger and was correctly concluded to be distinct, although the imperfect types and the doubtful inclusion of molars now known actually to belong to *Phenacolemur* made the resemblance seem closer than it is now found to be. The similarity of *Ignacius* was also recognized, but the upper teeth were not compared explicitly (those of Lower Eocene *Phenacolemur* not being surely placed in that genus). The lower teeth of correctly recognized reference were inadequate for proper comparison, and their much smaller size in the Tiffany suggested sharp distinction.

P³, P⁴ to M² and the entire lower dentition are now identified in "*Ignacius*" *frugivorus* and they permit detailed comparison with *Phenacolemur*. The general pattern is identical in the two, and the distinctions, aside from size, are all in minor details. These do not seem to warrant generic separation, and the Tiffany species is also placed in *Phenacolemur*.

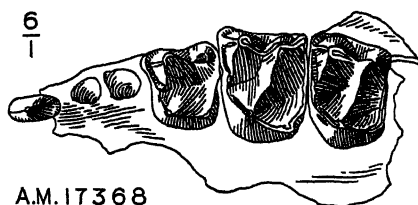


Fig. 5. *Phenacolemur frugivorus*. Type, Amer. Mus. No. 17368, left maxilla with P² and P⁴-M². Crown view. Six times natural size.



Fig. 6. *Phenacolemur frugivorus*. Amer. Mus. No. 17507, isolated lower incisor. External view. Four times natural size.

The incisor is much enlarged and its straight root is extended horizontally into the mandible to a point (not exactly determinable) under the molars, much as in *Labidolemur*. The crown has the general gracefully curved aspect of that of *Labidolemur*, but is simpler. Its section at the base is smoothly oval and it is modified near the tip only by flattening of the inner, medial, surface and development of a sharp but not elevated angulation below this surface, and another superoexternally. The crown is completely enameled and the enamel does not extend onto

the root. Its posterior margin has a small superoexternal embayment and a larger and more regular medial embayment which follows the mouth of the alveolus, the symphysis here extending forward (between opposite incisors) as a thin film of bone.

The lower cheek dentition is already adequately known in the genus, and the specific distinctions of *P. frugivorus* are noted below.

Despite the loss of all lower teeth between P_4 and the lower incisor, highly probable in *P. frugivorus* and certain in other species, there were

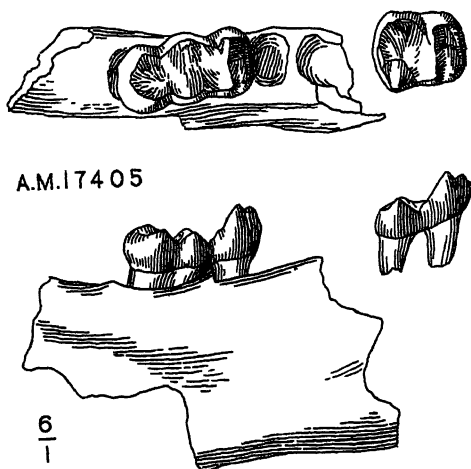


Fig. 7. *Phenacolemur frugivorus*. Amer. Mus. No. 17405, left lower jaw with M_2 - M_3 (although detached, M_2 is probably of this individual). Crown and internal views. Six times natural size.

at least two (probably only two) maxillary teeth anterior to P^4 . The more anterior, probably P^2 , is a small but two-rooted tooth, laterally compressed, rising to a single cusp followed by a non-cuspidate heel. This is followed by a very short diastema. P^3 is implanted by two roots, the posterior slightly larger. Its crown is unknown. P^4 is nearly as large as M^1 and is fully quadrate.¹ Paracone and metacone are distinct, but the metacone is considerably smaller. The protocone is nearly as large relatively as on the molars and is in the extreme anterointernal

¹ P^4 is also known in *Phenacolemur citatus* (in which it is almost identical in structure with that here described) but not hitherto figured or described in this genus.

position. From it a small crest, bearing a minute protoconule, runs to the parastyle, and another runs straight posteriorly, turns at an angle at the posterointernal corner, and continues as the posterior border of the crown, enclosing a large shallow basin, the floor of which slopes to the posterointernal corner. There is no distinct hypocone. An extremely faint ridge from the protocone tip in the direction of the metacone is barely visible on the protocone slope.

M^{1-2} , already described and figured in *Phenacolemur praecox* (Matthew 1915, pp. 480-481), are closely similar to each other, M^2 being slightly smaller. The structure is like that of P^4 but paracone and metacone are nearly equal and more widely separated and a definite crest runs from the protocone to the metacone.

The infraorbital foramen is anterior to the anterior root of P^4 , and the zygoma arises principally above M^2 , in part also M^3 .

***Phenacolemur frugivorus* (Matthew and Granger, 1921)**

Ignacius frugivorus, MATTHEW AND GRANGER, 1921.

TYPE.—Amer. Mus. No. 17368, left maxilla with P^3 and P^4 - M^2 .

PRINCIPAL REFERRED SPECIMENS.—Amer. Mus. No. 17408, incisor, P_4 , and M_1 . Amer. Mus. No. 17405, M_2 - $_3$.

HORIZON AND LOCALITY.—Mason Pocket, Tiffany Beds, Colorado.

DIAGNOSIS.— P^4 smaller relative to molars than in other known species. Metacone of P^4 smaller than in *P. praecox*. M^{1-3} angulate in outline, external borders nearly straight. Internal bases not bilobed. Heel of P_4 relatively long, external groove between trigonid and talonid pronounced. Measurements given below.

	P^4		M^1		M^2	
	L	W	L	W	L	W
Type:	1.7	1.9	1.9	2.5	1.7	2.5

	P_4		M_1		M_2		M_3	
	L	W	L	W	L	W	L	W
17408	1.6	1.1	2.0	1.6	...	...	...	...
17405	...	...	...	...	2.0	1.6	2.9	1.6

CARNIVORA

ARCTOCYONIDAE

Thryptacodon australis,¹ new species

TYPE.—Amer. Mus. No. 17384, associated lower jaws, nearly complete, with C-M₃ of both sides except left P₂. Left M¹ possibly associated. Possibly associated skeletal parts.

HORIZON AND LOCALITY.—Mason Pocket, Tiffany Beds, Colorado.

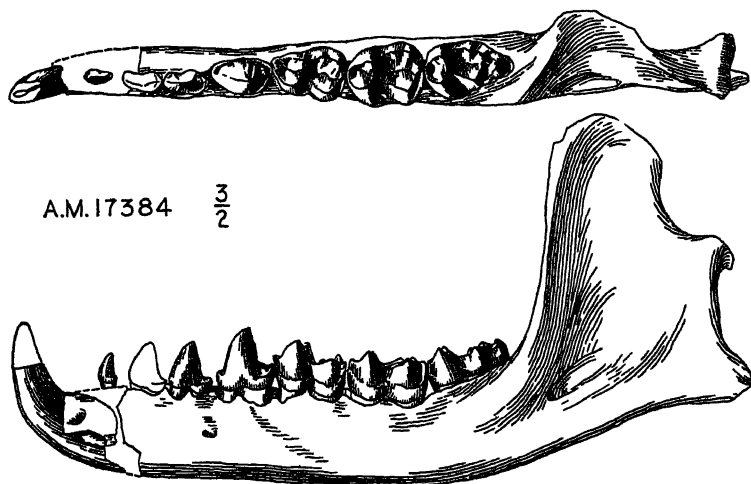


Fig. 8. *Thryptacodon australis*. Type, Amer. Mus. No. 17384, left lower jaw with C, P₁, P₂-M₃, and P₂ supplied in outline from other jaw of same individual. Crown and external views. One and one-half times natural size.

DIAGNOSIS.—M₁₋₃ about the same length as in small *T. antiquus*, but anterior teeth slender and less spaced, and whole jaw shorter and much more delicate and slender. Molars narrow and elongate. Paraconids more distinct than typical in *T. antiquus* and metastylids distinctly larger. Talonid of M₃ slightly more elongate, but M₃ as a whole shorter relative to M₂. M² with anteroexternal corner more angulate, external margin more sharply and deeply notched, and protoconule stronger.

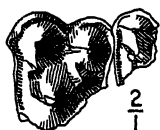
Thryptacodon antiquus of the Lower Eocene is a highly variable species and some of its extreme variants approach *T. australis* closely,

¹ This hitherto unpublished name appears on the label of the type in Matthew's hand, but no manuscript or notes by him referring to the species can be found and I am therefore forced to assume its authorship.

but the specimens are distinguishable in all cases and there is little doubt that the species are separate.

Skeletal fragments clearly of this species and probably of the type individual were found, including an atlas, humerus crushed but nearly complete, proximal ends of the two ulnae, and the two calcanea, somewhat broken. All these parts except the atlas are known in Lower Eocene *Thryptacodon*, and the present specimens are almost identical with the latter except for their much smaller size (hardly over half linear dimensions) and generally lighter structure. It is suggested that the skeleton was not as large relative to the skull, and certainly not relative to the molars, as in the later forms. The present specimen (assuming the skeletal parts to belong to the type) is, however, young— M_3 is fully erupted but none of the teeth are noticeably worn.

This fine specimen of age comparable to the French Cernaysian permits closer comparison with *Arctocyonides* of the latter, to which *Thryp-*



A.M.17384

Fig. 9. *Thryptacodon australis*. Amer. Mus. No. 17384, broken left M_2 and fragment of M_3 , probably associated with type. Crown view. Twice natural size.

tacodon has long been known to be closely related, but from which it has never been clearly distinguished. Outstanding distinctions appear to be as follows:

Thryptacodon

Lower canine very long and procumbent, root extending at least beneath P_2 .

Rudimentary metaconid on P_4 .

Paraconid well developed on M_1 , present but vestigial on M_2-3 .

Paraconid shifts to median position and there becomes vestigial.

Talonid of M_3 elongate, hypoconulid a spur projecting from the basin rim.

Arctocyonides

Root not extending beneath P_1 .

No metaconid on P_4 .

Paraconid vestigial on M_1 , absent on M_2-3 .

Paraconid internal, not median, fusing with metaconid.

Talonid of M_3 short, hypoconulid on basin rim.

These characters show that the genera are distinct, and in view of the general simplicity of pattern and the great amount of demonstrable convergence in animals with similar teeth, even suggest that they may not be very closely related.

Measurements of Type.— M_{1-3} : 20 mm.

M^2 length: 6.7 mm.

P_4		M_1		M_2		M_3	
L	W	L	W	L	W	L	W
5.4	2.8	6 3	4 3	7 0	5 5	6 7	4.6

Chriacus sp. indet.

Amer. Mus. No. 17194 is an isolated upper molar evidently of the genus *Chriacus* and near *C. schlosserianus*, but not that species. The species is doubtless new, but I prefer not to base a name on this poor specimen. It is not closer to the Eocene *C. gallinæ* than to the Paleocene species.

MESONYCHIDAE

?*Dissacus* sp. indet.

Amer. Mus. No. 17410 is an incomplete premolar, not more exactly identifiable than as probably *Dissacus* but possibly *Pachyaena*, as already stated by Granger (1917, p. 828). This tooth is from a coarse sandstone and is the one exception, mentioned by Granger, to the rule that the Tiffany fossils are from shale or clay.

CONDYLARTHRA

PHENACODONTIDAE

Granger (1917) noted the presence of three species of phenacodonts in this fauna, remarking that the largest is surely *Phenacodus* while the other two, being known from lower teeth only, might belong to *Tetraclænodon*. The latter possibility remains, but their association with an unquestioned *Phenacodus*, the fact that no specimen of *Tetraclænodon* has ever been found at a comparable horizon, and the fact that their structure throughout, while not absolutely decisive, is closest to that of known species of *Phenacodus* make their reference to the latter genus sufficiently probable. Assignment to *Ectocion* is also possible, but careful comparison suggests that they are closer to *Phenacodus*. Gidley suggested the existence at this level of a genus intermediate between *Tetraclænodon*

and *Phenacodus*, but so far as definitely diagnostic characters are shown in the present specimens, they are not intermediate but generically identical with *Phenacodus*.

The three species are all new. The material, although not so good as might be desired, is definable and it seems best to apply names to the species. No others of the same age have been named, with the possible exception of *Ectocion collinus* Russell, from the Paskapoo, based on a broken M^3 . This very inadequately known form is distinct from *P. grangeri*. It cannot be compared directly with *P. matthewi* or *P. gidleyi*, but as it seems to be a true *Ectocion*, while the latter are apparently not of that genus, the chance of synonymy is slight. Comparison with the known Clark Fork phenacodonts does not seem closer than with those of the Gray Bull, but is with the more primitive species of these later horizons.

***Phenacodus grangeri*, new species**

TYPE.—Amer. Mus. No. 17185, right maxilla with M^{1-2} and outer half of M^3 .

PARATYPES.—Amer. Mus. No. 17188, right P_4 .

Amer. Mus. No. 17198, right M_2 and M_3 , separate but probably associated.



Fig. 10. *Phenacodus grangeri*. Type, Amer. Mus. No. 17185, right M^{1-2} and half of M^3 . Crown view. Twice natural size.



Fig. 11. *Phenacodus grangeri*. Paratypes, Amer. Mus. Nos. 17188, 17187, and 17198. A, P_4 . B, M_1 . C, M_3 . (The original of B is of the left side and is reversed in drawing.) Crown views. Twice natural size.

Amer. Mus. No. 17187, left M_1 .

HORIZON AND LOCALITY.—Tiffany Beds, Colorado.

DIAGNOSIS.—Comparable to *Phenacodus primævus hemiconus* or to *P. p. intermedius* in size but upper molars more transverse, little reduced. Conules well developed. P_4 rounded-triangular, trigonid low, paraconid strong and simple, entoconid low and indistinct. M_2 - 3 closely similar to those of *P. p. intermedius*. Measurements below.

Type: M^{1-3} 29.0 mm.

M^1		M^2		M^3
L	W	L	W	L
9.7	12.7	10.9	14.4	9.6

Paratypes

P_4		M_1		M_2		M_3	
L	W	L	W	L	W	L	W
10.5	7.8	11.6	9.4	11.2	9.0	11.3	8.2

Phenacodus matthewi, new species

TYPE.—Amer. Mus. No. 17191, right lower jaw with M_2 - 3 .

HORIZON AND LOCALITY.—Tiffany Beds, Colorado.



A.M. 17191

Fig. 12. *Phenacodus matthewi*. Type, Amer. Mus. No. 17191, right M_2 - 3 . Crown view. Twice natural size.

DIAGNOSIS.—Intermediate in size between *P. vortmani* and *P. brachypternus*, or slightly nearer the latter. Molars broader than in *brachypternus*. Prominent entoconid on M_2 - 3 . Paraconid distinct. Jaw stouter and shallower than in specimens of *vortmani* or *brachypternus* of comparable age. Measurements of type below.

M ₂		M ₃	
L	W	L	W
7.5	6.9	7.9	5.7

Phenacodus gidleyi, new species

TYPE.—Amer. Mus. No. 17193, right P₄, M₁, and M₂, separate but associated.

HORIZON AND LOCALITY.—Tiffany Beds, Colorado.

DIAGNOSIS.—Molars comparable to *brachypternus* in length, but wider. Heel of M₂ very wide and short, hypoconulid barely projecting. P₄ not elongate, with distinct entoconid. Measurements of type below.



Fig. 13. *Phenacodus gidleyi*. Type, Amer. Mus. No. 17193, right lower teeth. A, P₄. B, M₁. C, M₂. Crown views. Twice natural size.

P ₄		M ₁		M ₂	
L	W	L	W	L	W
7.0	4.8	7.1	5.8	7.8	5.3

Phenacodus, sp. indet.

A single M³ seems too large for the last two species described, and does not agree with that of *P. grangeri*. It cannot properly be classified at present.

AMBLYPODA

Periptychus superstes Matthew, ex MS., new species

TYPE.—Amer. Mus. No. 17181, associated lower jaws with left P₄-M₂ and right P₄-M₂.

PARATYPES.—Amer. Mus. No. 17183, right ?Dm₄. (Apparently so identified by Matthew. It may be M₁.)

Amer. Mus. No. 17195, left M₂.

Amer. Mus. No. 17184, isolated P¹.

Amer. Mus. No. 17183, various fragments including ?P⁴. (So identified by Matthew; might be P³.)

HORIZON AND LOCALITY.—Tiffany, Colorado.

AUTHOR'S DIAGNOSIS.—“... In size it equals the larger individuals of *rhabdodon* but the heel of M_3 is longer, the inner crescentic cusp of P^4 is larger and more widely separated, the inner cusps of the trigonid of Dp_4 are higher than in Torrejon specimens, subequal in height to the protoconid and more widely separated from it.”

REVISER'S DIAGNOSIS.—Overall dimensions of jaw and dentition intermediate between *P. carinidens* and *P. rhabdodon*. Molars close to *rhabdodon* in size and structure, but talonid of M_3 more elongate. Premolars much smaller than in *rhabdodon*, more nearly as in *carinidens* or slightly less transverse.

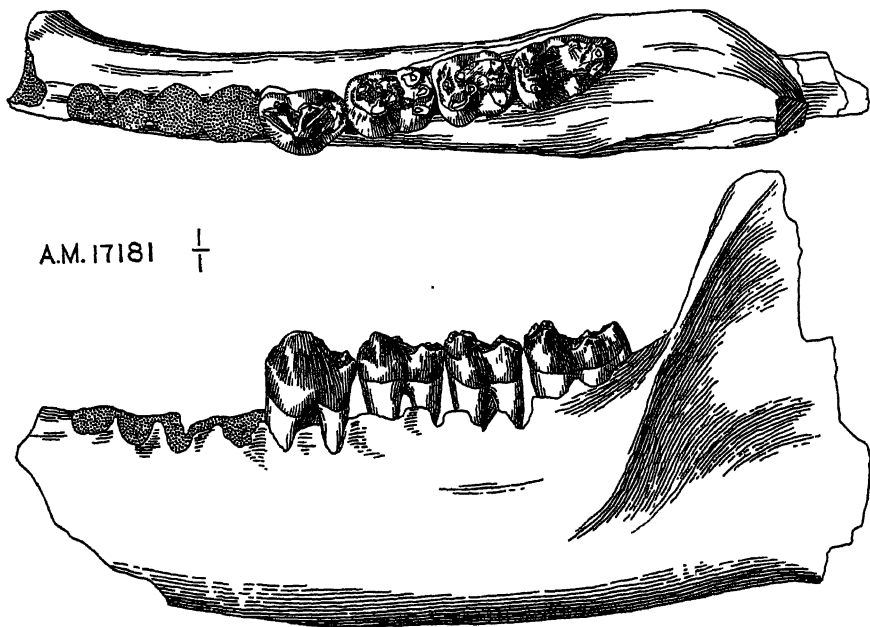


Fig. 14. *Peripitychus superstes*. Type, Amer. Mus. No. 17181, left lower jaw with P_4 - M_4 . Crown and external views. Natural size.

This appears to be the last of the peripitychids, none having as yet been found even in the only slightly later Clark Fork. It differs little from the Torrejon species and enters without question into this genus, but is at once distinguishable by the last premolar's being considerably smaller relative to the molar series than in either *P. rhabdodon* or *P. carinidens*, as well as by the other details cited above.

¹ Quoted from Matthew's Puerco-Torrejon memoir. He defines this as a mutation of *P. rhabdodon*. It seems to me as distinct from either *P. rhabdodon* or *P. carinidens* as they are from each other, and I therefore give it full specific rank here.

Measurements of type below.

M₁₋₃: 37.2 mm.

P ₁		M ₁		M ₂		M ₃	
L	W	L	W	L	W	L	W
12.3	9.1	11.3	9.2	10.5	9.2	14.6	8.9

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OCCURRENCE AND RELATIONSHIPS OF THE RÍO CHICO FAUNA OF PATAGONIA¹

BY GEORGE GAYLORD SIMPSON

In the last paper of this series the more important available fossils from the Río Chico Formation were described, figured, and, as far as new and definable, named. In the present paper the various fossil localities are enumerated, sufficient stratigraphic data given to specify the geologic provenience of the fossils as exactly as possible, the mammals found at each horizon and locality listed, and the general relationships and probable age of the fauna summarized. The field observations in this paper were made in 1930-31 and 1933-34 by the Scarritt Expedition. Acknowledgements of assistance received were made in the last paper.

CAÑADÓN HONDO

Cañadón Hondo is a valley, or more descriptively a nearly circular erosional basin, with a dry, winding watercourse which empties into the Río Chico del Chubut immediately above Paso Niemann. The stratigraphy here is very complex and extraordinary and its study is complicated by much pre-Patagonian (but post-Casamayor or later) faulting and local folding, by much slumping of the beds in the bottom of the basin, and the peculiar lithological facies which include several types of rocks not seen by us in these formations at any other locality. The very irregular valley or basin bottom has exposures in almost all parts, but a complete section cannot be traced because of rapid lateral lithologic changes, faulting and slumping, and frequent local lack of exposure at crucial points in the series. Short of a detailed topographic and geologic survey, beyond the possibilities of our own work, a definitive arrangement of this complex series is not possible, in fact absolute certainty on many points seems unobtainable by any method.

The broad sequence which seems probable from our own observations is as follows, beginning with the oldest beds:

1. Pale clays and massive, fine to coarse, cross-bedded sands, usually white or

¹ Publications of the Scarritt Expeditions, No. 25.

gray but often greenish or pink to red. Although physically similar and not certainly separable at present, these include two parts possibly distinct in age:

- a. A lower series without fossils, in which appears a "banco negro"—band of black or dark brown clays.
- b. An upper series of pale clays and sands in which are intercalated coarse sandstone lenses with mammals. Whole thickness not measurable but at least 100 feet.

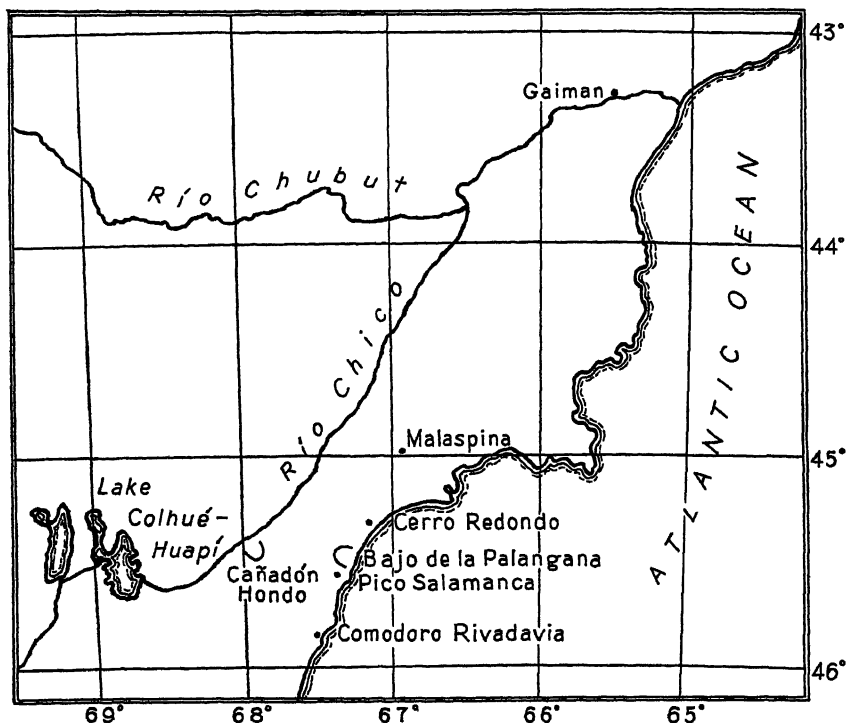


Fig. 1. Sketch map of part of central Patagonia, showing the localities mentioned in the text.

2. Green clay (bentonite) sometimes with bright red spots, scattered pebbles, associated with green and, more rarely, white sands. Whole thickness not measurable, but at least 125 feet. No fossils found.

3. Pale green, occasionally highly silicified (opalized) tufts of "argiles fissilaires" type (see McCartney 1934, pp. 4-5; rocks 74 and 75 are from this series) alternating with bright green clay (bentonite). In the lower part of this series are several thin but widespread beds of pure white rock, specific gravity less than that of water,¹

¹ This peculiar rock has been studied by G. C. McCartney and an X-ray analysis made by Professor P. F. Kerr. The latter notes that the X-ray pattern is of a crystalline mineral apparently not a clay mineral. McCartney notes angular glass fragments and a few zircon crystals and fragments of quartz and feldspar, but the preponderant mineral is not identified.

and also very thin-bedded fine sands and laminated shales. There are also local and minor intercalations, probably in this series, of purer or less altered tuffs or ash rocks, sometimes of the predominate green color but more rarely pink, yellowish, or white. Whole thickness not measurable, but at least 215 feet (measured in one continuous section). Fish and plant remains (see Berry 1932; field number 421 is from here) occur in the laminated beds, and mammals in the green opalized tuffs and bentonite. A small isolated exposure of pure green bentonite, probably in the upper part of this series, yielded numerous bird and rarer crocodile and turtle remains. Some isolated mammal fragment discoveries may also belong here.

4. More or less massive, white, pink, or rarely yellowish tuffs with some bentonite. The uppermost part has local lava intercalations, and this upper section may be more complex and of different age than the bulk of these pale tuffs. Whole thickness not measurable but at least 290 feet. Mammals found at various isolated localities, probably all in the middle or lower part of these tuffs.

5. The Patagonian marine, with a well-defined unconformity at its base.

The mammalian remains from groups 3 and 4 of this very generalized section are all of Casamayor age, and there is no doubt that this is all Casamayor (with the possible but unproved exception of a small part of the top of 4), in spite of the remarkable variation in lithology. The sands, 1b, which are the important point for present purposes, unquestionably underlie the proved Casamayor, and probably are considerably below it. Where the mammals occur, there are at least 30 feet of similar sands and clays above them. Beyond this the section cannot be traced continuously, but there are at least 150 feet, and probably considerably more, of sediments between these mammals and the lowest beds surely of Casamayor age. The presence of an unconformity is entirely possible, but cannot be definitely proved.¹

The matrix in which these ancient mammals occur consists (macroscopic examination) of grains of clear quartz, generally from 0.5 to 3.0 mm. in maximum diameter, with subordinate pink and white undecomposed feldspar grains, pellets and interstitial filling of yellowish or greenish bentonite, and minor amounts of subordinate minerals. There are some streaks of a black mineral probably magnetite. Most of it is technically medium coarse sandstone, varying from fine sandstone to granule conglomerate. The quartz grains are poorly rounded,

¹ Piatnitzky (1931, pp. 10-11) has briefly mentioned the geology of Cañadón Hondo. Although less detailed than the still summary account given here, Piatnitzky's views are in general compatible with mine. He states that the sandstone with mammals is 20 meters below the limy shales with fishes. I suggest that this figure cannot be exact, due to the inclination of the beds, the presence of numerous faults, lateral variation, and the absence of continuous exposures between the two sites, and that it is probably considerably too small. It should also be noted that petrographic study shows that he is mistaken regarding the nature of the bed in which the bird bones occur. It is not a somewhat silicified compact tuff but a very pure bentonite, like that occurring in almost all Casamayor exposures except for its green color. The hard beds which he mentions between the fish bed and the "*Strophocheilus* tuff" (the upper tuffs, 4 of my summary section) are, on the other hand, silicified tuffs and are almost identical with the "*argiles fissilaires*" except in color. They contain mammals of Casamayor age.

and many are fully angular. The feldspar, although much less abundant than quartz, seems to be undecomposed and the clayey material seems to be mostly bentonite and not kaolin, hence not a product of feldspar decomposition. Fresh surfaces are gray, sometimes with a greenish or yellowish tinge, and weathered surfaces tend to acquire a pale or decided orange tone. The particular lens from which most of our specimens came is strongly indurated, but does not effervesce with



Fig 2 Exposures of the Río Chico Formation in Cañadón Hondo

The greater part of the *Kibenhoria* fauna was gathered from the sandstone lens in the right foreground and others of the same character in the immediate vicinity

diluted hydrochloric acid. Adjacent beds, otherwise similar, are not indurated. These details are given because, with much variation, they characterize a type of rock common enough in itself but which does not appear ever to occur in the true Casamayor (or any other later formation of this region, at least until the Patagonian or still later strata which I have not examined in such detail).

The fossils are always isolated and most of them have been weathered, rolled, or broken before burial. The teeth, however, are usually

implanted in jaw fragments, and in a large proportion (nearly one half) of the specimens with teeth, more than one tooth is present. Complete dentitions were not found in any case, the nearest approach being a maxilla with six teeth.

This site was found by Ing. Alejandro Piatnitzky, who has already announced the discovery (1931, p. 11). I have also mentioned the occurrence previously (1932, pp. 6-8). The Scarritt Expedition worked here in March, 1931, and made the collection listed below. Feruglio also made a somewhat smaller collection, which has also been studied, but Piatnitzky's specimens are not included here. The mammals identified are as follows (descriptions in the previous paper):

MARSUPIALIA

Borhyaenidae

Patene sp

Polydolopidae

?*Polydolops kamektsen* Simpson

INC. SED

Gashsterna ctalehor Simpson

CONDYLARTHRA

Didelodontidae

Ernestokokenia yrunhor Simpson

?LITOPTERNA

Gen. et sp. indet.

NOTOUNGULATA

NOTIOPROGONIA

Henricosbornidae

Henricosbornia waitehor Simpson

?*Peripantostylops orehor* Simpson

?Notostylopidae

Gen et sp indet.

?Notioprogonia inc sed.

Seudenius cteronc Simpson

ENTELONYCHIA

Isotemnidae

?*Isotemnus ctalego* Simpson

Gen. et spp. indet.

TYPOTHERIA

Notopithecidae

?*Transpithecus* sp.

Gen. et sp. indet.

Acoelodidae

Kibenikhoria get Simpson

?TRIGONOSTYLOPOIDEA

Shecenia clurneru Simpson

The peculiar conditions of deposition make it unlikely that any identifiable large mammals will be found, but there were some large species, for a toothless jaw fragment, wholly unidentifiable, indicates an animal as large as *Thomashuxleya* or *Carodnia*. This does not invalidate comparisons, however, for the microfauna of the Casamayor is better known, or at least represented by many more specimens, than the macrofauna.

None of the identified species, and few of the genera, occur in the Casamayor. Even where the name of a Casamayor genus has been used for one of these animals, in most cases this is because the material is inadequate to define a new genus and not because it surely or even probably belongs to the Casamayor genus. In the case of *Henricosbornia* and, less clearly, of *Ernestokokenia* it does seem probable that the Casamayor genus occurs here, but in the other cases the Río Chico species will probably prove to belong to new genera when better known. That some Casamayor genera are common to the two faunas remains probable, but that this is true of any species seems very improbable.

The fauna is essentially primitive. The elements here present are, on the whole, the most primitive of the Casamayor fauna, and where closer comparison is possible the Río Chico species seem to be more primitive. *Ernestokokenia yirunhor* is a primitive form even within its primitive group. *Shecenia*, if really related to *Trigonostylops*, seems to be more primitive, at least in the somewhat smaller tusks and much larger tooth in the diastema. The henricosborniids are the most primitive of South American notoungulates. If *Seudenius* is a henricosborniid, it is very primitive in structure despite its larger size, and if it is either a notostylopoid or an isotemnid it is very primitive in its group both in size and in structure. *Isotemnus ctalego* is one of the most primitive known isotemnids. *Kibenikhoria* seems to be less advanced than its allies *Ultrapiethecus* and *Oldfieldthomasia*.

CERRO REDONDO

The hill to which we applied the descriptive field name Cerro Redondo is about one kilometer in diameter, near its base, and its apex is about five and one-half kilometers nearly due west of Puerto Visser.¹ Although fossils are few, the locality is one of outstanding stratigraphic importance, and I give the pertinent part of the section in full, starting at the base of the peak and ascending its southwest side.

¹ The official name of Puerto Visser seems to be Puerto Figueroa Alcorta, but I have never heard the latter name used. Our "Cerro Redondo" apparently does not have an official name. It appears on a sketch map by Tapia (1929, opposite page 502) as "Cerro Visser," and in an illustration (Pl. xx) as "Cerro de P[uerto] Visser."

a. Yellow-green to dark blue-green glauconitic sandstone with <i>Gryphaea</i>	Not measurable here.
b. Thin-bedded fine sands and shales with conchoidal fracture, shell casts and plant impressions.....	35 feet.
c. Green sandstone with fossil wood (the "Banco Verde" of local stratigraphers).....	20 feet.
d. Chiefly black shale ("Banco Negro" or "Banco Negro Inferior").....	15 feet.
e. Yellowish, greenish brown, to chocolate-colored clays with thin streaks of red.....	30 feet.
f. Gray to red clays with lenses of white, greenish, or red, coarse, cross-bedded sandstone.....	60 feet.
g. Cross-bedded white sandstone with red streaks.....	15 feet.
h. Clay and sandstone, similar to "f" but with rather less red and more gray sandstone. Mammals at base.....	75 feet.
i. Fairly persistent white sandstone.....	15+ feet.
j. Chiefly pale clays, some lenses of white sandstone.....	100 feet.
k. Cross-bedded sandstone and fine conglomerate. Mostly white or yellowish, but upper part a characteristic pale violet as seen from a distance.....	35+ feet.
l. Chiefly pale clay.....	55 feet.
m. Lens of hard cross-bedded gray sandstone, weathering reddish. Mammals.....	0-5 feet.
n. Soft gray to greenish sandstone.....	15 feet.
—Top of cerro, elevation about 725 feet above sea level—	

Practically all of the "clays" of this field section, including those of the Salamanca, and the "Banco Negro," are bentonites. On the basis of this section and of our rock specimens from it, McCartney (1933, p. 15) has shown not only that beds "a" and "c" (the "Banco Verde") are glauconitic (as has long been known), but also that glauconite is an important constituent of parts of bed "e." While it is possible that the glauconite is here secondary, it is suggested that marine and semi-marine conditions may have persisted or recurred until after the deposition of this stratum. If so, the Salamanca (in the broadest sense) perhaps should not be taken as ending beneath the "Banco Negro Inferior" but some 45 feet higher, in this section. There are many local erosional unconformities in the section, but none can be selected as of sure regional significance.

The lowest mammals found are from the base of "h," 120 to 125 feet (36.5 to 38 meters) above the base, or 105 to 110 feet (32 to 33.5 meters) above the top, of the "Banco Negro Inferior." This is 8 to 9.5 meters nearer the base and 4.5 to 6 meters nearer the top of the "Banco Negro Inferior" than the lowest mammals found elsewhere (see Bajo de la Palangana, below) and to these few teeth belongs

the honor of being the oldest mammalian remains yet found in South America. They were collected by C. S. Williams and O. García Fanjul.

Bed "m," which also contains mammals, is about 280 feet (85 to 86 meters) above the lowest mammals found and about 385 feet (117 to 118 meters) above the top of the "Banco Negro Inferior." It corre-

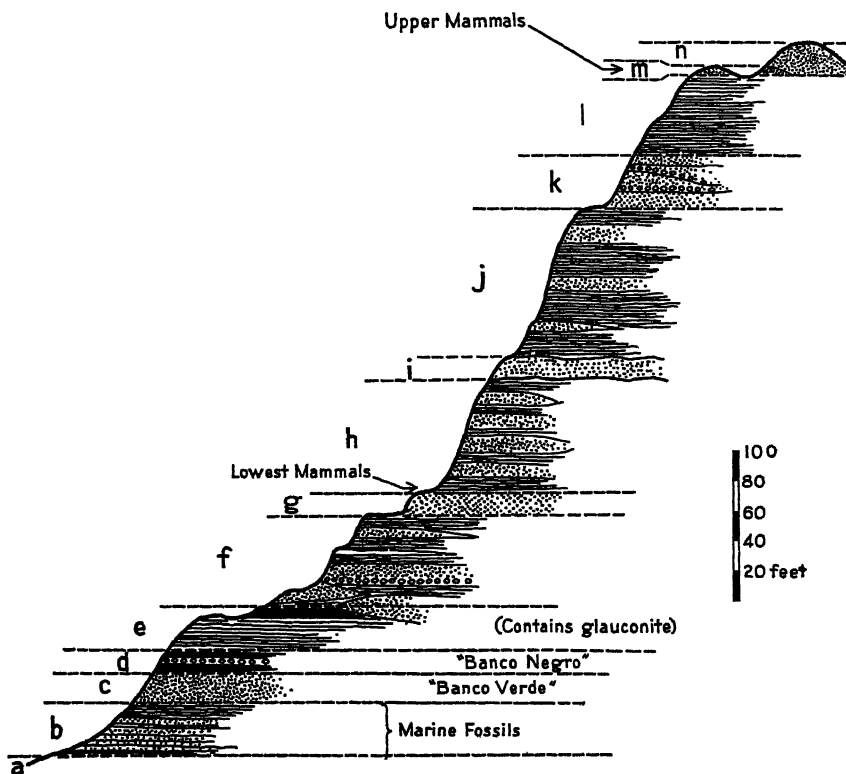


Fig. 3. Diagrammatic section of Cerro Redondo near Puerto Visser. For explanation of reference letters see text.

sponds, within a few feet, to the richest upper sandstone of the Bajo de la Palangana (see below). This horizon is at or immediately below the base of the Casamayor tuffs, although these have been eroded at this point and do not appear in the cerro itself. The fossils found are as follows:

1. Base of bed "h" of above profile.

Crocodylidae, indet. (Scutes, skeletal fragments, isolated teeth.)

?Borhyaenidae, indet. (Canine fragment.)

Seumadia yapa Simpson.

Wainka tshotshe Simpson.

Wainka tshotshe? (Lower molar perhaps of this form.)

2. Bed "m" of above profile.

Chelonia indet. (Carpape fragment.)

Dasyopodidae indet. (Two scutes, suggestive of *Utaetus*.)

Isotemnidae indet. (A lower molar representing a small and primitive member of this family.)

?Notopithecidae indet. (Lower jaw fragment with one broken tooth, suggestive of this family but not exactly matched in any other specimen known to me.)

Aside from the fact that both faunules are clearly Tertiary and that they are both more suggestive of the Casamayor than of any later fauna, but that neither compares exactly with any definitely Casamayor faunule, the fossils do not cast much light on correlation. (1) has only two exactly identifiable mammals, both distinctly different from any known from any other horizon and locality. (2) has no identifiable forms, but suggests a primitive Casamayor-like fauna. Both are consistent with the stratigraphic evidence that (2) is slightly and (1) definitely earlier than the true Casamayor. On clear stratigraphic evidence, (2) corresponds to the fairly extensive fauna from the highest sandstones of the Palangana section, listed below, while (1) is somewhat, but perhaps not significantly, earlier than the horizon of *Carodnia* in the Palangana basin.

BAJO DE LA PALANGANA

The Bajo de la Palangana ("Washbowl Basin") is an erosional basin near the coast north of Pico Salamanca, separated from the Solano Basin by that peak and the spur which connects it with the Pampa de Castillo. It is in this region that von Huene found the possible dinosaur claw (1929, pp. 13-14) and I have previously mentioned the locality and given a photograph of a "Pehuenche" (= Río Chico) exposure (1932, pp. 5-6, and Fig. 3). In 1931 we visited this locality, took several sections of the middle and upper beds exposed, and collected a small number of mammals. In 1934 I again visited the basin with Ing. José Brandmayr, who kindly indicated to me the exact horizons of the specimens found by him and by Dr. Egidio Feruglio.

In this general area the Salamanca Formation is exposed (along and near the coast, especially at Punta Peligro), capped by the "Banco Negro Inferior" of local workers, here about 8 meters in thickness. Then follows a series of sands and clays, partly or wholly terrestrial,

115 to 118 meters thick. (These figures were supplied by Ing. Brandmayr.) Above these are normal Tertiary tuffs, 285 feet thick according to our measurements at Pico Chico, three kilometers north of Pico Salamanca, and representing the Casamayor only. The Patagonian overlies the Casamayor with marked erosional but not angular unconformity.



Fig. 4. Red beds of the lower Río Chico Formation in the Bajo de la Palangana, near the type locality of *Carodnia feruglioi*.

The series intercalated between the Salamanca and the Casamayor, is divisible lithologically into three members. The lower member is 24 meters thick and has a thin, dark, somewhat irregular bed, identified by Feruglio and Brandmayr as the "Banco Negro Superior," at its upper limit. No fossils have been surely recorded in this member and its age is not clear. The middle member, up to 55 meters in thickness, consists predominately of thick cross-bedded red or red and white sandstones, with intercalated clay lenses. The upper member is 30 to 35 meters thick where measured by us, and differs from the middle

member in the more commonly white or gray, rarely pink, color of the sandstone, and the predominance of yellowish, greenish, or reddish clay, being more a clay series with sandstone lenses than a primarily sandstone series like the middle member. The fossil evidence is inadequate to determine whether these lithologic members are also temporal units, but this is a distinct possibility. The middle and upper



Fig. 5. The northern part of the Bajo de la Palangana.

In the foreground the upper Río Chico capped (near the level of the low bench visible across the middle of the picture) by sands with the *Ernestokokenia chaishoer* fauna. The cliffs above this, in the background, are formed by the Casamayor, unconformably overlain by the Patagonian marine beds, which also form the highest and most distant slopes visible.

members at least are of fluvial nature and have many local erosional unconformities, the regional value of any one of which can only be surely determined on paleontological data.

In the middle member, three fossil discoveries are known to me. Brandmayr found mammal remains 14 meters above the "Banco Negro Superior," 38 meters above the more persistent and surely identifiable "Banco Negro Inferior" and 77 to 80 meters below the base of the Casamayor tuffs. This material is now in the Museo de La

Plata.¹ Feruglio found a small lot of mammal remains, at least two individuals, *in situ* in a bed of red sandstone approximately 19 meters above the "Banco Negro Superior" and another small lot, of one or two individuals, in the same bed, in part *in situ* and in part weathered out, 20 meters above the "Banco Negro Superior." These specimens are described in the previous paper. All three discoveries are within a span of six meters stratigraphically, and represent essentially contemporaneous animals.

In the upper member, bone fragments may be found in most of the sandstone beds by long search. Identifiable specimens, however, have so far been found in this basin only in the upper part of this member, and particularly in a persistent hard sandstone, about six meters below the Casamayor tuff (from which it is separated by clays or bentonites which could belong to either series) and 65 to 74 meters above the mammals referred to in the preceding paragraph. This sandstone contains abundant bone fragments, but well preserved teeth are relatively rare and almost always isolated. We have a few specimens from in or near this horizon, but the list given below is almost exclusively based on a large collection made by Feruglio.

1. 19 to 20 meters above the "Banco Negro Superior," in fine red sandstone:

Carodnia feruglioi Simpson

Catacarodnia cabrerai Simpson.

2. 85 to 88 meters above the "Banco Negro Superior" and about six meters below the Casamayor tuffs, in coarse gray to pink sandstone.

MARSUPIALIA

Polydolopidae

Polydolops winecage Simpson.

CONDYLARTHRA

Didolodontidae

Ernestokokenia chaishoer Simpson.

Ernestokokenia ?yirunhor Simpson.

LITOPTERNA

?Proterotheriidae

Victorlemoinea sp.

Ricardolydekkeria sp.

Josepholeidya sp.

NOTOUNGULATA

NOTIOPROGONIA

Henricosborniidae

Henricosbornia ?lophodonta Ameghino.

Henricosbornia sp.

?*Polystylops* sp.

¹ See note at end of this paper.

?*Postpithecus* sp.

Gen. et spp. indet.

?*Notostylopidae*

?*Notostylops* sp.

ENTELONYCHIA

Isotemnidae

Isotemnus cf. *primitivus* Ameghino

Isotemnus sp.

TYPOTHERIA

Notopithecidae

?*Notopithecus* sp.

Gen. et spp. indet.

TRIGONOSTYLOPOIDEA

Trigonostylopidae

Trigonostylops sp.

Of (1) nothing can be said except that the animals are from very old strata and that nothing closely similar to them has ever been found elsewhere. (2) is clearly similar to but not the same as the older Casamayor faunules. Most of its genera seem to be the same as Casamayor genera, although in the case of queried names it is probable that a generic distinction exists, although not definable from the isolated and often imperfect teeth available. The species are probably in large part new, although only two are exactly identifiable as such. In other cases (e.g., *Victorlemoinea*, *Josepholeidya*, ?*Postpithecus*) the species are probably new but cannot be defined because surely homologous Casamayor teeth are not available, and in still others (e.g., *Ricardolydekkeria*, *Henricosborniidae* gen. et sp. indet., ?*Notopithecus* sp.) the species are also probably new but the material inadequate for definition. *Ernestokokenia yirunhor* is a Cañadón Hondo, Río Chico Formation, species probably but not surely present here also and *Henricosbornia lophodonta* is a Casamayor (probably only Lower Casamayor) species probably present here. The fauna thus has the aspect of being close to the Casamayor but slightly earlier.

PICO SALAMANCA

On the south side of Pico Salamanca much of the Río Chico Formation is exposed, but neither top nor bottom contact was found by us. Starting at the shore there is about 30 meters of red (and in lesser part white and green) cross-bedded sandstone, apparently corresponding to the "middle member" of the Palangana section, and above this 20 meters or more of white to gray clay with lenses of white to pink sandstone. The upper part is obscured by slumped blocks of Patagonian. In the

upper sandstone lenses of this upper pale clay series, and probably near the level of the most fossiliferous upper sandstone of the Bajo de la Palangana, mammals occur. We found a dasypod scute and an upper incisor of *Notostylops* or some related genus, in place at this level. On the bench at the base of the cliff we found a lower premolar of *Notostylops* or a closely related genus and an upper molar of *Oldfieldthomasia*, but as these were not in place their evidence is not conclusive. The locality would repay more prolonged study than we were able to give it.

LAS VIOLETAS

On the estancia "Las Violetas," southeast of the small settlement of Malaspina, there is a long cliff with the Salamanca Formation at its base, followed by about 125 feet of fragmental and detrital, barren volcanic strata, then by a bentonite bed, up to 25 feet thick and often black at the base (probably "Banco Negro Superior"). Immediately above this clayey horizon begins a series with bentonite, sands of Río Chico character, and some white tuff. In the base of this last series, in hard sandstone, rare mammal bones occur. We found nothing more exactly determinable than a dasypod scute, and the locality has no present paleontological interest, but is mentioned as another possible site for Río Chico mammals, worthy of further investigation.

GAIMAN

Mammals were first found in the ancient sandstones near Gaiman by Roth. The rather complex history of this find and the misunderstandings that have arisen concerning it have already been reviewed in some detail (Simpson 1935a) and need not be repeated. Aside from Roth's specimens in La Plata and a few collected by us, there are several interesting specimens collected by A. F. Bordas, in the Museo Argentino, not yet described. The following fossils are known to me:

*Polydolops rothi*¹ Simpson

?*Polystylops minutus* (Roth) [*Monolophodon minutus*]

Isotemnus haugi (Roth) [*Lelfunna haugi*]

Notopitheciidae indet.

Thus Casamayor groups are represented by distinct and apparently more primitive species, and although the very few specimens available do not warrant exact correlation, this is the character of the Río Chico fauna, with which lithology and stratigraphy are also in accordance, although not absolutely conclusive.

¹ A species known only from this locality. It is described in a paper in press at the Museo de La Plata.

RÉSUMÉ AND CONCLUSIONS

Of the various small faunules found in what is lithologically the Río Chico Formation, the following are most important:

- 1 a The lower fossils from the Bajo de la Palangana
- b The lower fossils from the Cerro Redondo near Puerto Visser. These two small lots are from near the same level and the same general region



Fig 6 The Pan de Azúcar, near Gaiman.

The foreground is formed by the Río Chico sandstones, with barren ?Casamayor, Trelew, and Patagonian in the slope and cliff beyond

2. The Cañadón Hondo sandstone fauna.
3. The upper sandstone fauna from the Bajo de la Palangana and vicinity.
4. The sandstone fauna of Gaiman.

(1) contains fossils not known from any other horizon and locality and not in themselves permitting positive correlation beyond the fact that they are of Tertiary aspect and are in agreement with the other evidence of a distinct and older mammalian faunal zone. The stratigraphic data, unusually clear in these cases, show that these are from the middle or lower part of the Río Chico. It cannot surely be estab-

lished whether they are significantly different in age from (2), but if so they are probably somewhat older.

(2), which may be considered the typical Río Chico fauna, is a fauna of early Tertiary, South American type. On present evidence, it appears to have no species in common with the Casamayor. It probably includes some Casamayor genera, but at least half and probably more of the genera are not known from any later horizon. The

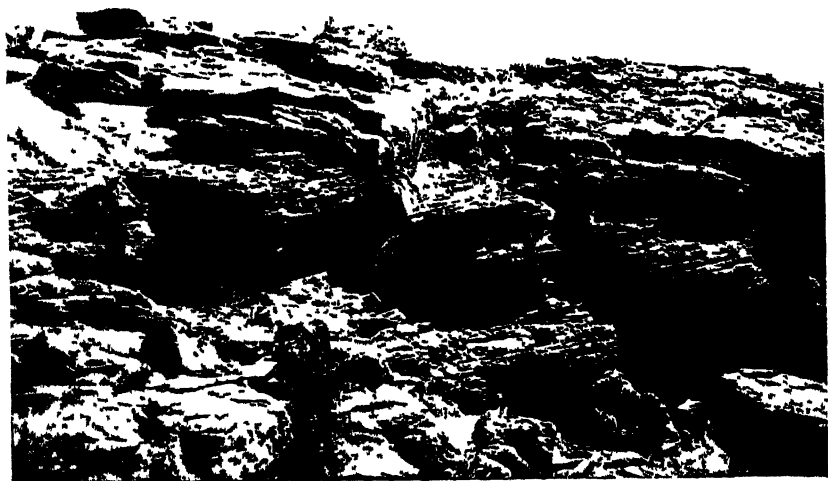


Fig. 7. Close-up of the mammal-bearing sandstone of probable Río Chico age near Gaiman.

fauna is thus quite distinctive, as much so as is customarily true of two successive major Tertiary formations, and is of ancient type. Stratigraphically its zone underlies the Casamayor.

(3) resembles the Casamayor definitely more than does (2). In the latter there are no Casamayor species and few genera, while in (3) a few species and most of the genera are also found in the Casamayor. On this basis, it is highly probable that (3) is younger than (2), and stratigraphically, also, it is closer to the Casamayor, being from the highest sandstone perhaps immediately below, and certainly not over

six meters below, typical Casamayor sediments, with no evidence of a significant unconformity.

Both faunally and stratigraphically, (3) is closer to the Casamayor than it is to (2). On the other hand it is still distinct from the true or typical Casamayor and its horizon is lithologically part of the Río Chico. It is in effect a proto-Casamayor or a transitional Río Chico-Casamayor fauna. Whether this distinct faunal zone should be included nominally in Casamayor or Río Chico is an academic question, as long as its character and position are recognized. It seems to me somewhat better to include it provisionally in the Río Chico despite its close relation to the Casamayor. Certainly a complete gradation of faunas existed, and presumably intervening faunules now lacking will be found in these beds still so inadequately explored paleontologically. Somewhere in the sequence a division will have to be established between zones that differ no more than do (3) and the Lower Casamayor, and it is a point of practical importance that this division corresponds to the major change in sedimentation and lithology if, as now seems to be the case, the paleontological evidence also permits the recognition of such a boundary.

(4) is still too poorly known to warrant any worth-while deduction. As a hypothesis that seems to accord with present scanty data but requires further testing before elevation to the dignity of a theory, it may correspond approximately to (3).

There seem, then, to be at least two distinct pre-Casamayor faunal zones in the strata here under consideration. The Cañadón Hondo zone, with its distinctive and typical Río Chico fauna, is older, and the upper Palangana zone is younger, transitional to the Casamayor, to which it might conceivably be referred as a distinctive basal zone. The horizon of (1) in the list above may be approximately equivalent to but is probably somewhat older than the Cañadón Hondo zone, but fossils are still too few to determine this or, if it is older, to determine whether it can be characterized as a third separate and oldest zone.

As to the age of Río Chico, until 1931 no one seems to have differed from Ameghino's original opinion that these strata are Cretaceous. Ameghino considered them (correctly) as being related in a general way rather to his "Notostylopense" than to the still older Pehuenche (of Ameghino, not of more recent authors) and Chubutiano or "Areniscas Abigarradas," but he considered the "Notostylopense," Casamayor, as Cretaceous. When it was established beyond much question and generally accepted that the Casamayor is Tertiary, all students still

maintained that the beds now called Río Chico were Cretaceous. Except for lithologic resemblance, the positive evidence for this view, such as the supposed presence of dinosaurs and absence of mammals or the supposed angular unconformity, was all erroneous, but no positive evidence opposed this opinion.

Even after his discovery of mammals in these beds, Piatnitzky was inclined to continue considering them as Cretaceous, writing (1931, p. 16) that "antes de estudiar estos fósiles, sería aventurado llegar a una conclusión con respecto a la edad de las areniscas. De todos modos, su posición estratigráfica muy baja y la semejanza entre su composición litológica y la del Pehuenche propiamente dicho,¹ talvez indiquen su pertenencia al Cretáceo, a la cual época, por consiguiente, deberían referirse los huesos de mamíferos encontrados en las mismas areniscas." Feruglio considered the question open to further discussion, without himself expressing an opinion, saying of the mammal finds of Piatnitzky and of Brandmayr (Feruglio 1931, p. 22) that "estos hallazgos, junto a las consideraciones que he expuesto arriba,² ponen en discusión la edad (terciaria o bien cretácea) del Pehuenche,³ cuya aclaración sólo puede esperarse de un estudio paleontológico."

I have already (1932B, pp. 7-8; 1933, pp. 11-12) expressed the opinion that the Río Chico Formation is definitely Tertiary, and this opinion now seems to me to be proved correct beyond any doubt. The only remaining evidence for Cretaceous age is that mentioned by Piatnitzky, the low position of the Río Chico and its lithologic character. Since the Casamayor is certainly not as old as the base of the Paleocene, a formation, or even a series of several thick formations, below it need not necessarily or probably be Cretaceous merely because of this lower position. In North America there are several thousand feet of Tertiary sediments below the oldest formation that is at all likely to be equivalent in age to the Casamayor. As to lithology, its evidence carries no weight if confronted by any positive opposing data. That the change in type of sediments corresponds to the Cretaceous-Tertiary boundary was a justified hypothesis as long as no other basis for separation existed, but immediately falls to the ground now that there is better evidence for drawing the line. The type of sedimentation continued the same for

¹ I.e., the beds above the Salamanca in which mammals have not yet been found. Their age and correlation is still in doubt. Much of them probably belongs to the Río Chico, but the presence of post-Salamanca Cretaceous is entirely possible.

² The absence of any authenticated discovery of dinosaurs contemporaneous with these mammals.

³ I.e., Río Chico.

some time into the Tertiary, or the earliest Tertiary beds were formed by material remanié from the Upper Cretaceous strata.¹

The Río Chico fauna includes many mammals, mostly ungulates in a broad sense and already distinctly differentiated into the Tertiary orders, or even families, and does not include dinosaurs. Such a fauna has never been found in any other part of the world except in the Tertiary. It is not inconceivable that such a fauna might exist somewhere in the Cretaceous, but the burden of proof is on the opinion that it might be Cretaceous.

From another approach, it is a necessary assumption that the original stocks of the South American mammals were connected with those of some other part of the world, and it is highly probable that the connection was in the latest Cretaceous or earliest Paleocene. The Río Chico mammals, primitive as they are, are considerably removed from and differentiated beyond possible connection with the earliest known and most nearly similar mammals of any other part of the world, and hence are probably considerably post-Cretaceous.

Another and less theoretical line of evidence is afforded by the few Río Chico mammals that do compare at all closely with those known from other continents. *Patene*, very primitive as a borhyaenid, is yet considerably more advanced in this direction than the latest Cretaceous marsupials of North America. *Ernestokenia* closely resembles Middle Paleocene to Lower Eocene condylarths of North America (and Europe), and I think it is closely related to them both in blood and in degree of evolutionary advance. The Río Chico henricosborniids resemble, and are about as advanced as, the Upper Paleocene and Lower Eocene arctostylopids of Asia and North America. If *Carodnia* is related to the uinatheres, which is possible but still hypothetical, its closest allies are from the Upper Paleocene of Asia and North America.

A fourth sort of faunal evidence concerns the relation of the Río Chico fauna to later South American faunas. The age of the Casamayor is not known with any exactness. It is almost surely Eocene, and long consideration of all the evidence convinces me that it cannot be older than Lower Eocene and may be Middle Eocene or even, but with much less probability, Upper Eocene. Supposing it to be as old as any evidence warrants considering it, Lower Eocene, then the Río Chico fauna (*Kibenikhoris* zone) could hardly be judged as older than Middle

¹ Furthermore the strata with which Platnitsky was making special lithologic comparison are not themselves definitely known to be of Cretaceous age. It should also be mentioned that the lithologic change is not so definitely associated with the beginning of a period of strong vulcanism as might be supposed, for volcanic rocks of many types are very characteristic of the undoubted Cretaceous also.

Paleocene, from its general evolutionary level and degree of resemblance to the Casamayor fauna.

The conclusion on these considerations is that the Río Chico fauna is certainly Tertiary and that its age is with much probability somewhere in or between the Middle Paleocene and the Lower Eocene. Upper Paleocene seems most likely, but is a more exact correlation than the evidence warrants.

Since the known Río Chico fauna is probably not of earliest Tertiary age and since its notoungulates suggest previous differentiation which almost surely took place in South America, it is to be expected that still older Tertiary faunas occurred there and it is to be hoped that they are preserved and will yet be discovered. If a real fauna were found in the *Carodnia* zone, it might possibly prove to be older than that of *Kibenikhor* and would in part fill in this remaining gap. In the meantime, the fossils here described are the oldest known South American mammals.

To facilitate further discussion of and reference to these problems, I suggest that the possibly distinct faunules within the Río Chico be tentatively designated as follows:

FORMATION

ZONES AND FAUNAS

Río Chico

Ernestokokenia chaishoer (3 of list given above)*Kibenikhor* (2 of list given above)*Carodnia* (1 of list given above)

ADDENDUM TO NOVITATES NO. 793

Since the descriptions of the Río Chico fossils were published I have received from Doctor Cabrera casts of the two specimens found by Ing. Brandmayr in the *Carodnia* zone of the Bajo de la Palangana, as mentioned on a previous page. Doctor Cabrera will describe these, but they are mentioned here to complete reference to all that is yet known of the Río Chico formation and fauna. One is identical in structure with the type of *Carodnia feruglioi*, and I suspect it of being the right *M*₃ of the same individual. The other is a premolar unlike any specimen otherwise known from the formation and of uncertain affinities.

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STUDIES OF PERUVIAN BIRDS. XVIII¹

DIAGNOSES OF NEW SPECIES AND SUBSPECIES OF FURNARIIDAE FROM PERÚ AND OTHER PARTS OF SOUTH AMERICA

By JOHN T. ZIMMER

Owing to various circumstances, it has been impossible to print in full the descriptions of various species of Peruvian birds which have been in manuscript for some time. Consequently, it has been deemed advisable to extract from this manuscript the diagnoses of the new forms which have been discovered and to publish them in advance. The more detailed descriptions and the discussions of interrelationships and variation are in hand and will be published as soon as possible in the present series of "Studies."

Geositta cunicularia titicacae, new subspecies

TYPE from Tirapata, Titicaca Basin, Perú; altitude 12,700 feet. No. 145,146, American Museum of Natural History. Adult male collected July 30, 1916, by F. M. Chapman and G. K. Cherrie.

DIAGNOSIS.—Similar to *G. c. frobeni* of the arid Pacific slopes of the Andes in southwestern Perú (described from Putre, Chile), but much more warmly colored; under parts strongly buffy except for a restricted white throat patch; pectoral spots averaging heavier, back more brownish and less grayish. Differs from *juninensis* of the Junín region by having the color of the upper parts a little warmer, the pectoral spots heavier and darker, and the bill averaging heavier. Wing (of type), 99 mm.; tail, 55; exposed culmen, 15; culmen from base, 21; tarsus, 22.

RANGE.—High plateau region of southeastern Perú, Bolivia, and probably northwestern Argentina.

This is the form to which the name "*frobeni*" has been applied heretofore. Since the pale form living in the immediate vicinity of Arequipa agrees better with the characters given for *frobeni* and since the type locality of *frobeni* (Putre, Chile) is in the same general arid foothill region on the western side of the Andes as is Arequipa, the name is better applied to the Arequipa form, leaving the highland subspecies to be described as herewith.

¹ Earlier papers in this series comprise American Museum Novitates Nos. 500, 509, 523, 524, 538, 545, 558, 584, 647, 668, 703, 728, 753, 756, 757, and 785.

***Phleocryptes melanops brunnescens*, new subspecies**

TYPE from Chorrillos, Perú. No. 165,783, American Museum of Natural History. Adult male collected February 14, 1913, by R. H. Beck; original No. 160.

DIAGNOSIS.—Similar to *P. m. melanops* of Paraguay, but general color of upper parts brown instead of blackish; outer margins of lateral interscapulars buffy brownish rather than grayish with the pale stripe between the outer border and the shaft less strikingly whitish; wing-band paler rufous with the spot on the inner web of the fourth (and frequently the fifth and sixth) remix (from the outside) not reaching the shaft; the area of the remiges just distad of the rufous band less deeply blackish though darker than the tips of the remiges. Separable from *P. m. schoenobaenus* of the Peruvian highlands by these same characters but, in addition, by smaller size, agreeing better with typical *melanops* in this respect.

Males: wing, 57.5–59 mm.; tail, 44.5–52; culmen from base, 17.5–19; tarsus, 20.5–22. Female: wing, 54; tail, 44; culmen from base, 18.25; tarsus, 18.5.

RANGE.—Coast of Perú from about the vicinity of Lima north to Trujillo.

***Synallaxis albenscens australis*, new subspecies**

TYPE from Puerto Pinasco, Paraguay. No. 149,500, American Museum of Natural History. Adult male collected September 11, 1916, by George K. Cherrie; original No. 19,721.

DIAGNOSIS.—Similar to *S. a. albenscens* of eastern Brazil and eastern Paraguay, but mantle duller, more grayish brown; rufous cap varied by olive-gray tips on the feathers; rufous outer margins of upper wing-coverts reduced and usually restricted to the basal portion of the feathers; throat with broader whitish tips on lower feathers, more effectually concealing the blackish bases. Wing (of type), 56 mm.; tail, 67; exposed culmen, 10; culmen from base, 13.5; tarsus, 18.

RANGE.—Western Paraguay, southward to Buenos Aires, Argentina, and north-westward to central Bolivia.

***Synallaxis albenscens inaequalis*, new subspecies**

TYPE from Villa Bella Imperatriz (Santa Clara), south bank of Rio Amazonas, Brazil. No. 277,091, American Museum of Natural History. Adult male collected August 11, 1930, by the Olalla brothers.

DIAGNOSIS.—Similar to *S. a. josephinae* of British Guiana and southwestern Venezuela (vicinity of Mt. Duida), but much paler; back with a grayish tinge about as in specimens of *S. a. perpallida* from the state of Lara, Venezuela, but rufous color of cap and upper wing-coverts decidedly darker than in Lara birds, paler than in *josephinae*, between the colors of *trinitatis* and *occipitalis*; throat and belly very pure whitish, flanks grayish with little buffy tone, resembling *nesiotis*; breast very pale ashy gray or whitish. Wing (of type), 54 mm.; tail, 68; exposed culmen, 10.5; culmen from base, 15; tarsus, 19.5.

RANGE.—South bank of the Amazon between the Madeira and Tapajoz rivers, crossing to the north bank in the same general region and extending northward to French Guiana.

***Synallaxis albenscens trinitatis*, new subspecies**

TYPE from Princetown, Trinidad Island. No. 59,294, American Museum of Natural History. Adult male collected April 15, 1893, by Frank M. Chapman; original No. 3209.

DIAGNOSIS.—Similar to *S. a. nesiotis* of Margarita Island and Cumaná, Venezuela, but back buffy brown instead of gray; rufous color of cap and upper wing-coverts noticeably darker. Compared with *S. a. josephinae* of British Guiana and southwestern Venezuela, the color is paler; back more buffy brown; rufous of cap and wing-patch noticeably lighter; breast less grayish; flanks paler brownish; sides of head lighter gray. Compared with *occipitalis* of the Mérida region, the differences are somewhat like those distinguishing it from *josephinae* but not so strong in dorsal aspect. Wing (of type), 57 mm.; tail, 75; exposed culmen, 10.5; culmen from base, 14.25; tarsus, 19.5.

RANGE.—Trinidad Island and Venezuela from the northeastern corner south-westward to the middle Orinoco as far west as the Río Caura.

***Synallaxis albens insignis*, new subspecies**

TYPE from Quetame, eastern Andes of Colombia; altitude 4800 feet. No. 122,-024, American Museum of Natural History. Adult female collected February 26, 1913, by Frank M. Chapman, George K. Cherrie, and others.

DIAGNOSIS.—Similar to *S. a. occipitalis* of Mérida, Venezuela, but general coloration paler; rufous of crown and occiput more restricted, partially withdrawn from the nuchal region, and leaving the grayish frontal band proportionately broader; chest paler, less grayish; rufous of upper wing-coverts somewhat paler; back lighter in color, more tinged with brownish; malar region paler gray. Compared with *S. a. trinitatis* of Trinidad, northeastern Venezuela, and the middle Orinoco, a paler chest, more restricted crown-patch, and slightly larger bill are distinctive. Compared with *S. a. albicularis* of Perú and eastern Ecuador, the coloration is much paler and the tail is longer, with less acute, less decomposed rectrices. Wing (of type), 57 mm.; tail, 82.5; exposed culmen, 10; culmen from base, 15; tarsus, 20.5.

RANGE.—Eastern Colombia, in the Magdalena Valley and on the eastern side of the eastern Andes. Birds from central and western Colombia are intermediate between this form and *hypoleuca* of eastern Panamá.

***Synallaxis azarae carabayae*, new subspecies**

TYPE from Santo Domingo, southeastern Perú; altitude 6000 feet. No. 146,173, American Museum of Natural History. Adult male collected September 4, 1916, by Harry Watkins; original No. 65.

DIAGNOSIS.—Similar to *S. a. azarae* of north-central Bolivia, but darker. Breast and sides of head darker gray; chin and throat with narrower whitish tips, leaving more black exposed on the lower throat; belly grayer, less whitish; crown and occiput darker rufous; outer surface of wings and upper wing-coverts deeper and clearer rufous; mantle darker brown; forehead darker and browner, less grayish; under wing-coverts deeper ochraceous. Compared with *infumata* of the Junín region, the mantle and under parts are darker, the forehead-band is narrower; the rufous of the wings is deeper; the tail is shorter; the belly is grayer, less whitish. Wing (of type), 55 mm.; tail, 85.5; exposed culmen, 10; culmen from base, 14; tarsus, 21.

RANGE.—Carabaya district of southeastern Perú, extending southeastward to the region of La Paz, western Bolivia.

***Synallaxis azarae urubambae*, new subspecies**

TYPE from Torontoy, Urubamba Cañon, Perú; altitude 7800 feet. No. 145,182, American Museum of Natural History. Adult male collected July 7, 1916, by Frank M. Chapman and George K. Cherrie.

DIAGNOSIS.—Similar to *S. a. azarae* of north-central Bolivia, but with outer margins of remiges duller and browner in some contrast to the rufous upper wing-coverts; rufous of crown and nape averaging slightly darker; breast and sides darker gray; lores and lower eyelid less extensively white; belly, particularly in the females, with much stronger development of dark lunules; tail with a greater amount of dark olive shading; outer rectrices entirely dull olivaceous gray without any rufous tinge. Compared with *S. a. infumata* of the Junín region, the breast is a little darker; the belly is more broadly whitish but, in the female, more strongly marked with darker lunules; the rufous cap is paler; the dark forehead-band is narrower; the tail is more obscured; the outer margins of the remiges are duller, less rufescent. Compared with *S. a. carabayae* the general color is paler, the outer margins of the remiges are duller; the belly is more whitish and, in the female, more prominently lunulated with darker color. Wing (of type), 57 mm.; tail, 82.5; exposed culmen, 11; culmen from base, 15; tarsus, 21.5.

RANGE.—Apparently restricted to the Uruhamba Valley, eastern Perú.

Synallaxis unirufa ochrogaster, new subspecies

TYPE from La Lejía, north of Chachapoyas, Perú; altitude about 9000 feet. No. 234,712, American Museum of Natural History. Adult male collected February 28, 1925, by Harry Watkins; original No. 8839.

DIAGNOSIS.—Similar to *S. u. unirufa* of eastern Colombia and eastern Ecuador but general color a little duller and less rufous; belly decidedly paler, broadly ochraceous, rather than rufous. Wing (of type), 62.5 mm.; tail, 89; exposed culmen, 10.5; culmen from base, 16; tarsus, 23.

RANGE.—Northern Perú, south of the Marañón.

Synallaxis rutilans dissors, new subspecies

TYPE from Campos Salles, Manaus, Brazil. No. 248,587, American Museum of Natural History. Adult male collected August 26, 1928, by the Olalla brothers.

DIAGNOSIS.—Similar to *S. r. rutilans* of the south bank of the lower Amazon, but mantle averaging a little warmer brown, less olivaceous, with less rufous coloration laterally; interscapulars without a strongly developed patch of chestnut, often entirely brown, and scapulars also extensively brown, with the chestnut area much restricted; hind neck without trace of rufous collar. Wing (of type), 61 mm.; tail 67; exposed culmen, 11; culmen from base, 14; tarsus, 19.

RANGE.—Brazil north of the Amazon and east of the Rio Negro, extending up the left bank of the Negro to southwestern Venezuela (crossing the Cassiquiare and the Orinoco and possibly the highest portion of the Rio Negro at Marabitanas), and descending the Orinoco to the Río Caura; ascending the Rio Branco in Brazil and reaching French and Dutch Guiana.

Synallaxis rutilans confinis, new subspecies

TYPE from Igarapé Cacao Pereira, Rio Negro (right bank), Brazil. No. 312,067, American Museum of Natural History. Adult male collected December 23, 1929, by the Olalla brothers.

DIAGNOSIS.—Similar to *S. r. amazonica* from the south bank of the middle and upper Amazon, but general tone of rufescence averaging lighter, without the trace of olive on the occiput usually present in *amazonica*; outer margins of remiges somewhat

browner; tail decidedly shorter. Differs from *S. r. caquetensis* of southeastern Colombia, eastern Ecuador, and northeastern Perú by paler coloration. Wing (of type), 59 mm.; tail, 54; exposed culmen, 11; culmen from base, 15; tarsus, 20.

RANGE.—At present known only from near the right bank of the lower Rio Negro, Brazil.

***Certhiaxis cinnamomea orenocensis*, new subspecies**

TYPE from Ciudad Bolívar, Venezuela. No. 177,379, American Museum of Natural History. Adult male collected April 7, 1905, by George K. Cherrie; original No. 13,306.

DIAGNOSIS.—Similar to *C. c. cinnamomea* of the Guianas and northeastern Brazil but duller; back more sandy and less rufescent, in decided contrast to the wings and forehead; sides, flanks, and under tail-coverts paler; tail and wings paler rufous; tail apparently always with a noticeable dusky area on the distal portion of the inner webs of the median rectrices. Wing (of type), 60 mm.; tail, 62; exposed culmen, 12; culmen from base, 15.5; tarsus, 19.

RANGE.—Lower Orinoco region of Venezuela.

***Certhiaxis cinnamomea pallida*, new subspecies**

TYPE from Igarapé Cacao Pereira, Rio Negro (right bank), Brazil. No. 313,089, American Museum of Natural History. Adult male collected January 19, 1930, by the Olalla brothers.

DIAGNOSIS.—Differs from *C. c. cinnamomea* by much paler coloration; from *C. c. cearensis* by much duller hues and paler and more grayish sides and flanks; from *C. c. orenocensis* by clearer and brighter rufescent upper parts, without a dusky spot on the median rectrices. Wing (of type), 57.5 mm.; tail, 51; exposed culmen, 12; culmen from base, 16.5; tarsus, 19.

RANGE.—Lower Amazonia, from the Rio Jamundá to the west bank of the Rio Negro, Brazil, and from the east bank of the Rio Tapajoz to the west bank of the lower Rio Madeira.

***Cranioleuca marcapatae*, new species**

TYPE from Marcapata, southeastern Perú; altitude, 10,800 feet. No. 448,909, American Museum of Natural History. Adult of uncertain sex, collected by G. Ockenden (probably in 1905).

DIAGNOSIS.—Differs from *C. a. albiceps* of western Bolivia by having the whole top of the head and back of the neck uniform with the mantle which is deeper rufous than in *albiceps*; rump strongly tinged with rufous; under parts paler; sides of head lighter, buffy instead of sooty gray; under wing-coverts brighter, more ochraceous; throat more broadly but less purely whitish. Wing (of type), 71 mm.; tail, 73.5; exposed culmen, 12.75; culmen from base, 17.75; tarsus, 22.5.

RANGE.—Known only from Marcapata, Perú.

***Cranioleuca albiceps discolor*, new subspecies**

TYPE from Incachaca, Province of Cochabamba, Bolivia; altitude 7700 feet. No. 137,283, American Museum of Natural History. Adult male, with enlarged gonads, collected May 20, 1915, by L. E. Miller and Howarth Boyle; original No. 11,906.

DIAGNOSIS.—Similar to *C. a. albiceps* of western Bolivia, but top of head deep buffy ochraceous instead of white. Wing (of type), 67 mm.; tail, 70; exposed culmen, 14; culmen from base, 17; tarsus, 21.

RANGE.—Subtropical Zone of the Cochabamba region of central Bolivia.

***Pseudocolaptes boissonneautii orientalis*, new subspecies**

TYPE from above Bacza, northeastern Ecuador, No. 173,784, American Museum of Natural History. Adult male, collected September 10, 1922, by Carlos Olalla and sons.

DIAGNOSIS.—Similar to *P. b. boissonneautii* of Colombia, but with the top of the head blacker (less brownish) and less prominently streaked with buff; mantle with the pale shaft-stripes broader and more sharply defined, with the margins of the feathers sooty; superciliary stripe weaker and buffy instead of white; lower throat and breast much more heavily margined with dark brown, the feathers of the belly also more or less distinctly tipped with a narrow dark border. Wings and tail slightly darker rufous. Wing (of type), 117.25 mm.; tail, 98; exposed culmen, 17; culmen from base, 22; tarsus, 30.

RANGE.—Eastern side of the Andes of Ecuador, crossing to the western slopes in the extreme southern part of that country.

This is the bird long misidentified as *johnsoni*, which proves to be a very distinct form, possibly specifically distinct from the *boissonneautii* group.

***Pseudocolaptes boissonneautii pallidus*, new subspecies**

TYPE from Taulis, northeast of Pacasmayo, Perú; altitude 8850 feet. No. 235,915, American Museum of Natural History. Adult female collected June 19, 1926, by Harry Watkins; original No. 10,529.

DIAGNOSIS.—Nearest to *P. b. medianus* of the Chachapoyas region of Perú, but lower under parts decidedly paler; stripes on mantle less strongly marked, with narrower pale centers and lighter brown, less dusky, margins. Wing (of type), 110 mm.; tail, 101; exposed culmen, 26; culmen from base, 30; tarsus, 26.5.

RANGE.—Northwestern Perú in the Subtropical Zone, on the western slope of the Andes south of Porculla Pass.

***Hylocryptus erythrocephalus palamblae*, new subspecies**

TYPE from Palambla, Dept. Piura, Perú. No. 175,314, American Museum of Natural History. Adult male collected September 19, 1922, by Harry Watkins, original No. 6083.

DIAGNOSIS.—Similar to *H. e. erythrocephalus* of Alamor, Ecuador, and vicinity, but paler throughout; head, upper and under tail-coverts, wings, and tail paler rufous; back grayer, less brownish; breast and belly paler buff; wing and tail averaging slightly smaller. Wing (of type), 95 mm.; tail, 88; exposed culmen, 28; culmen from base, 33; tarsus, 28.

RANGE.—Western slope of western Andes of Perú in the neighborhood of Palambla.

***Thripadectes holostictus moderatus*, new subspecies**

TYPE from Nequejahuirá, Río Unduavi, Bolivia; altitude 8000 feet. No. 229,-225, American Museum of Natural History. Adult male collected May 21, 1926, by G. H. H. Tate.

DIAGNOSIS.—Similar to *T. h. holostictus* of Colombia and Ecuador, but ventral pattern less bold; chin almost unmarked; lateral margins of the feathers of throat and chest less sooty, nearer light brownish olive; pale streaks of lower breast and upper flanks narrower; belly and lower flanks sometimes quite immaculate; rufous of rump deeper and less extended anteriorly; tail duller and darker rufous; outer surface of wings darker; pale streaks on mantle narrower and less sharply defined. Wing (of type), 92 mm.; tail, 98; exposed culmen, 21; culmen from base, 25.5; tarsus, 26.25.

RANGE.—Subtropical Zone of southeastern Perú and northern Bolivia in the Amazonian drainage (possibly descending to the upper levels of the Tropical Zone).

***Xenops minutus remoratus*, new subspecies**

TYPE from Tatú, Rio Negro (right bank), Brazil. No. 434,636, American Museum of Natural History. Adult male collected June 9, 1929, by the Olalla brothers.

DIAGNOSIS.—Somewhat similar to *X. m. ruficaudus* of the Guianas, Mt. Duida, and the region east of the Rio Negro, Brazil, but top of head not conspicuously streaked; general coloration above and below duller, with pectoral markings less sharply defined; tail averaging shorter. Similar, also to *X. m. genibarbis* of the south bank of the lower Amazon, but general color much duller; shoulder less rufescent; top of head similarly unstreaked. Wing (of type), 65 mm.; tail, 44.5; exposed culmen, 12; culmen from base, 15.5; tarsus, 14.

RANGE.—Right bank of the upper Rio Negro, Brazil, merging with *ruficaudus* on the Rio Cassiquiare.

***Xenops rutilans peruvianus*, new subspecies**

TYPE from Idma, above Santa Ana, Urubamba Valley, Perú; altitude 5000 feet. No. 145,216, American Museum of Natural History. Adult female collected July 12, 1916, by Chapman and Cherric.

DIAGNOSIS.—Similar to *X. r. heterurus*, but with less black in the tail, in typical birds without any definite black on the outer webs of any of the rectrices, except at the concealed bases, nor on the inner web of the submedian pair near the tip. Differs from *X. r. purusianus* in the same respect and also by a brighter, more ochraceous tinge in the olive of the under parts and with the pale areas of throat, breast, and belly less purely white, with a faint tinge of pale yellowish; under tail-coverts distinctly warmer and often less prominently striped; wing and tail averaging longer. Pattern of tail intermediate between that of *purusianus* and *guayae*. Differs from *septentrionalis* by more dusky, less rufous, brown on the top of the head, a warmer color of the under parts and possibly a slightly darker maxilla. Wing (of type), 73 mm.; tail, 47; exposed culmen, 12; culmen from base, 14; tarsus, 15.

RANGE.—Most of the humid Tropical Zone of Perú; in typical form, inhabiting eastern Perú on the Ucayali and Huallaga rivers and the southeastern portion of the country; in northwestern Perú and southern Ecuador, east of the Andes, approaching *heterurus*.

***Xenops rutilans chapadensis*, new subspecies**

TYPE from Chapada, Matto Grosso, Brazil. No. 33,658, American Museum of Natural History. Adult male collected February 17, 1885, by H. H. Smith.

DIAGNOSIS.—Similar to *X. r. rutilans* of Bahia in respect to the amount of black on the tail, but differs in the warmer coloration, especially of the under parts, and in the more extensive dark margination of the lower throat; mantle always strongly streaked with white, averaging stronger than in *rutilans* and sometimes very decidedly so; subexternal primary more often with traces of a rufous patch on the inner web; third primary (from outside) rarely (one out of seventeen skins) without a noticeable (if small) rufous mark (in *rutilans* the third primary is usually unmarked, the second rarely marked); wings and tail averaging deeper rufous. Wing (of type), 65.25 mm.; tail, 48.5; exposed culmen, 11; culmen from base, 14; tarsus, 14.75.

RANGE.—Plateau of Matto Grosso, Brazil, apparently eastward along the highlands to Piahy and Maranhão.

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BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. XXX¹

DESCRIPTIONS OF TWENTY-FIVE NEW SPECIES AND SUBSPECIES

By ERNST MAYR

Various circumstances are delaying the publication of the detailed descriptions of many of the new species and subspecies collected by the Whitney Expedition. It was therefore decided to publish, as an abstract of the complete paper, the following preliminary descriptions. The detailed paper, with tables of measurements and discussions on variation, relationship and nomenclature, is ready for the press and will be published in the present series as soon as possible.

Haliaeetus sanfordi, new species

TYPE.—No. 220671, Amer. Mus. Nat. Hist.; ♂ ad.; Choiseul Island, British Solomon Islands; November 28, 1927; R. H. Beck, F. P. Drowne, and H. Hamlin.

Differs from *H. leucogaster* by its brownish plumage and its blackish tail (9 adults and 4 immatures examined). Field observations confirm the result of the study of the specimens.

RANGE.—All Solomon Islands.

Gallicolumba sanctaecrucis, new species

TYPE.—No. 220554, Amer. Mus. Nat. Hist.; ♂ ad.; Tinakula, Santa Cruz Islands; March 4, 1927; R. H. Beck.

ADULT MALE. Chin and uppermost throat whitish; rest of throat and upper breast buffy vinaceous on a white basis; forehead, sides of head and sides of neck light grayish; pileum and nape grayish brown, sometimes with a slight purplish gloss; back, scapulars, rump, and upper tail-coverts with a strong purplish-violaceous gloss; this coloring is sometimes restricted to the edge of the feather, the center being more greenish; patch of feathers on the sides of the lower neck, and the lesser and median upper wing-coverts with a strong violaceous gloss; lower breast, belly and under tail-coverts grayish brown; iris brown, bill black, feet red. Wing, 138–145 mm.

RANGE.—Tinakula and Utupua, Santa Cruz Archipelago.

¹ Previous papers in this series comprise American Museum Novitates, Nos. 115, 124, 149, 322, 337, 350, 356, 364, 365, 370, 419, 469, 486, 489, 502, 504, 516, 520, 522, 531, 590, 609, 628, 651, 665, 666, 709, and 714.

***Gallicolumba jobiensis chalconota*, new subspecies**

TYPE.—No. 220556, Amer. Mus. Nat. Hist.; ♂ ad.; Vella Lavella Island, British Solomon Islands; November 15, 1927; R. H. Beck and F. P. Drowne.

Similar to *G. j. jobiensis*, but white on lores and superciliary much reduced.

RANGE.—Vella Lavella and Guadalcanar Island, Solomon Islands.

***Ceyx lepidus pallidus*, new subspecies**

TYPE.—No. 224750, Amer. Mus. Nat. Hist.; ♂ ad.; Bougainville Island, Solomon Islands; February 3, 1928; F. P. Drowne, H. Hamlin, and G. Richards.

Similar to *Ceyx lepidus meeki*, but under parts pale yellowish buff, instead of golden-yellowish ochre.

RANGE.—Buka and Bougainville, Solomon Islands.

***Ceyx lepidus malaitae*, new subspecies**

TYPE.—No. 226876, Amer. Mus. Nat. Hist.; ♀ ad.; Malaita Island (3000 feet), Solomon Islands; April 1, 1930; H. Hamlin, W. F. Coultas, and W. J. Eyerdam.

Similar to *Ceyx lepidus nigromaxilla*, but lighter throughout; under parts yellow-ochre, not deep ochraceous orange; back methyl-blue, not deep purplish violet.

RANGE.—Malaita Island.

***Halcyon chloris mala*, new subspecies**

TYPE.—No. 226877, Amer. Mus. Nat. Hist.; ♂ ad.; Malaita Island, Solomon Islands; February 4, 1930; H. Hamlin, E. Mayr, W. F. Coultas, and W. J. Eyerdam.

Differs from *H. c. alberti* by smaller size, paler ochraceous under parts, and more greenish upper parts; wing, 98–105 mm.

RANGE.—Malaita, Solomon Islands.

***Halcyon chloris pavuvu*, new subspecies**

TYPE.—No. 224957, Amer. Mus. Nat. Hist.; ♂ ad.; Pavuvu Island, Solomon Islands; August 2, 1927; R. H. Beck and F. P. Drowne.

Buffy loreal spots much enlarged, in other characters intermediate between *alberti* and *mala*; wing, 105–114 mm.

RANGE.—Pavuvu Island, Solomon Islands.

***Ninox jacquinoti floridae*, new subspecies**

TYPE.—No. 220676, Amer. Mus. Nat. Hist.; ♂ ad.; Florida Island, Solomon Islands; May 24, 1927; R. H. Beck.

Differs from *N. j. jacquinoti* (wing, 195–208 mm.) by larger size (wing, 218–223 mm.).

RANGE.—Florida Island, Solomon Islands.

***Ninox jacquinoti mono*, new subspecies**

TYPE.—No. 448907, Amer. Mus. Nat. Hist. (Rothschild Collection); ♂ ad.; Mono (Treasury Island), Solomon Islands; December 8, 1901; A. S. Meek.

Differs from *Ninox jacquinoti eichhorni* by the reduction of the whitish bars on the wing; wing, 190-196 mm.

RANGE.—Mono or Treasury Island, Solomon Islands.

***Tyto alba interposita*, new subspecies**

TYPE.—No. 215566, Amer. Mus. Nat. Hist.; ♂ ad.; Vanikoro, Santa Cruz Islands; September 21, 1926; R. H. Beck and J. G. Correia.

Differs from the neighboring races by the buffy to ochraceous wash of the under parts and the prevalence of the orange-ochre color throughout the plumage; wing, 268-279 mm.

RANGE.—Santa Cruz Islands, Banks Islands, and Northern New Hebrides.

***Tyto alba crassirostris*, new subspecies**

TYPE.—No. 335322, Amer. Mus. Nat. Hist.; ♀ ad.; Boang Island, Tanga group, Bismarck Archipelago; February 4, 1935, W. F. Coultas.

Differs from *T. a. delicatula* by the stronger bill and feet, and the darker coloration; wing, 285-290 mm.

RANGE.—Known only from the type-locality.

***Collocalia pelewensis*, new species**

TYPE.—No. 332022, Amer. Mus. Nat. Hist.; ♀ ad.; Palau Island, Micronesia; December 11, 1931; W. F. Coultas.

Small; tarsus naked; upper parts dark fuscous-green, with a brownish tone on the back; crown not very much darker than back; rump pale but no distinct light gray bar across the rump as in *spodiopygia*; there is much individual variation in the color of the rump, the bases of the feathers always being pale gray, the tips, however, sometimes being strongly glossy green, sometimes grayish; inner margins of the wing-feathers not particularly light; feathers of chin and throat soft and decomposed, with fuscous bases and rather sharply defined silvery gray edges, but no shaft-streaks; abdomen dull gray, slightly darker than throat, inconspicuous shaft-streaks on breast and abdomen, more pronounced ones on under tail-coverts; longest under tail-coverts fairly glossy green; white loreal spot inconspicuous. Wing, 109-115 mm.

RANGE.—Palau Islands.

***Collocalia vanikorensis ponapensis*, new subspecies**

TYPE. No. 331343, Amer. Mus. Nat. Hist.; ♀ ad.; Ponape, Caroline Islands; November 22, 1930; W. F. Coultas.

Similar to *C. v. inquieta* (wing, 117-123 mm.) and *C. v. rukensis* (wing, 112-119.5 mm.), but smaller (wing, 106-113 mm.).

RANGE.—Ponape, Caroline Islands.

***Collocalia lowi orientalis*, new subspecies**

TYPE.—No. 225168, Amer. Mus. Nat. Hist.; ♂ ad.; Guadalcanar, Solomon Islands; May 28, 1927; R. H. Beck.

Similar to *Collocalia lowi whiteheadi*, but much darker and with a pale rump; tarsus with a few feathers; wing, 132 + x mm.

RANGE.—Guadalcanar, Solomon Islands.

Pitta anerythra nigrifrons, new subspecies

TYPE.—No. 228390, Amer. Mus. Nat. Hist.; ♂ ad.; Tauro, Choiseul Island, Solomon Islands; November 2, 1929; H. Hamlin.

Differs from *P. a. anerythra* by the greater extent of black on the crown; wing, 96–101 mm.

RANGE.—Choiseul Island, Solomon Islands.

Coracina lineata makirae, new subspecies

TYPE.—No. 227953, Amer. Mus. Nat. Hist.; ♂ ad.; San Cristobal, Solomon Islands; December 7, 1929; E. Mayr, W. F. Coultas, and W. J. Eyerdam.

Similar to *Coracina lineata malaitae*, but the male with distinct narrow white bars on breast and upper belly, and with black and broader white bars on the gray of lower belly and under tail-coverts; wing, 133–143 mm.

RANGE.—San Cristobal (Makira), Solomon Islands.

Turdus margaretae, new species

TYPE.—No. 228058, Amer. Mus. Nat. Hist.; ♀ ad.; San Cristobal, Solomon Islands (1900 ft.); December 18, 1929; E. Mayr, W. F. Coultas, W. J. Eyerdam.

Upper parts uniformly colored, olivaceous brown, darker and duller on the head, warmer and more rufous on lower back and rump; scapulars of the same color as back; although the back seems to have a uniform color, most feathers show an indication of a dark terminal or subterminal band; feathers of lores, superciliary, and cheeks with white bases and blackish tips; sides of head brownish, feathers with whitish shaft-streaks; breast olivaceous gray, every feather with broad gray base, with a subterminal triangular white spot or band, and a broad olivaceous brown or blackish edge; sides of breast and flanks similar, but triangular white spots larger and more longitudinal; middle of belly, thighs, and under tail-coverts white; wing dark brown, outer webs of primaries and secondaries warmer brown (burnt umber); tertials with small white or buff subterminal spots; upper wing-coverts blackish brown with round white subterminal spots; primary-coverts uniform brownish; lesser set of under wing-coverts whitish, median set black, greater set grayish as under side of wing; white band across underside of wing from the fifth primary to the innermost secondary; tail uniform brown without white marks on the outermost tail-feathers. Wing, 91–99 mm.

RANGE.—San Cristobal, Solomon Islands.

Vitia parens, new species

TYPE.—No. 228063, Amer. Mus. Nat. Hist.; ♂ ad.; San Cristobal, Solomon Islands; December 11, 1929; E. Mayr, W. F. Coultas, W. J. Eyerdam.

General coloration brownish; forehead and fore parts of crown ochraceous brown; hind neck, scapulars, back, and rump a dull grayish olivaceous brown (chucker brown);

tail brownish; chin, upper throat and sides of head pale ochraceous; breast, flanks, belly, and under tail-coverts brownish gray; wing brown, edges of outer primaries paler, more cinnamon brown; female like male, but somewhat duller and darker particularly on forehead and upper throat. Wing (σ^7), 60-61 mm.

RANGE.—San Cristobal, Solomon Islands.

Vitia ruficapilla castaneoptera, new subspecies

TYPE.—No. 252011, Amer. Mus. Nat. Hist.; σ^7 ad.; Vanua Levu, Fiji Islands; February 3, 1925; R. H. Beck.

Differs from *badiceps* (Viti Levu) by being more brownish, particularly on wings and tail; wing (σ^7), 56-62 mm.

RANGE.—Vanua Levu, Fiji.

Vitia ruficapilla funebris, new subspecies

TYPE.—No. 251970, Amer. Mus. Nat. Hist.; σ^7 ad.; Tavium, Fiji Islands; December 15, 1924; R. H. Beck.

Differs from *V. r. badiceps* by larger size and its darker and duller coloration; wing (σ^7), 59-65 mm.

RANGE.—Taviuni, Fiji.

Phylloscopus trivirgatus bougainvillei, new subspecies

TYPE.—No. 225174, Amer. Mus. Nat. Hist.; σ^7 ad.; Bougainville, Solomon Islands; January 5, 1928; F. P. Drowne, H. Hamlin, and G. Richards.

Differs from *P. t. becki* by its paler coloration of the under parts and the reduction of the white tips on the lateral tail-feathers; wing (σ^7), 56-60 mm.

RANGE.—Bougainville, Solomon Islands.

Phylloscopus trivirgatus pallescens, new subspecies

TYPE.—No. 225198, Amer. Mus. Nat. Hist.; sex ?; Kulambangra, Solomon Islands; September 27, 1927; F. P. Drowne.

Differs from *P. t. bougainvillei* by the almost whitish under parts, the less blackish crown and the more conspicuous superciliary.

RANGE.—Kulambangra, Solomon Islands.

Phylloscopus trivirgatus makirensis, new subspecies

TYPE.—No. 228069, Amer. Mus. Nat. Hist.; σ^7 ad.; San Cristobal, Solomon Islands; December 12, 1929; E. Mayr, W. F. Coultas, and W. J. Eyerdam.

Similar to *poliocephalus*, but back more citrine, crown less grayish, under parts richer yellow; wing, 49-55 mm.

RANGE.—San Cristobal Island, Solomon Islands.

Monarcha castaneiventris obscurior, new subspecies

TYPE.—No. 219711, Amer. Mus. Nat. Hist.; σ^7 ad.; Pavuvu Island, Solomon Islands; August 24, 1927; R. H. Beck and F. P. Drowne.

Similar to *M. c. castaneiventris*, but darker; axillaries partly and thighs completely black; bluish black of throat extending farther down on breast and flanks; wing (♂), 81–86 mm.

RANGE.—Pavuvu Islands, Solomon Islands.

***Monarcha barbata ganongae*, new subspecies**

TYPE.—No. 219536, Amer. Mus. Nat. Hist.; ♂ ad.; Ganonga Island, Solomon Islands; October 25, 1927; R. H. Beck.

Intermediate between *nigrotecta* (Vella Lavella) and *browni* (Kulambangra); black throat-patch small as in *nigrotecta*, but greater and tips of median upper wing-coverts white as in *browni*; wing (♂), 83–87 mm.

RANGE.—Ganonga Island, Solomon Islands.

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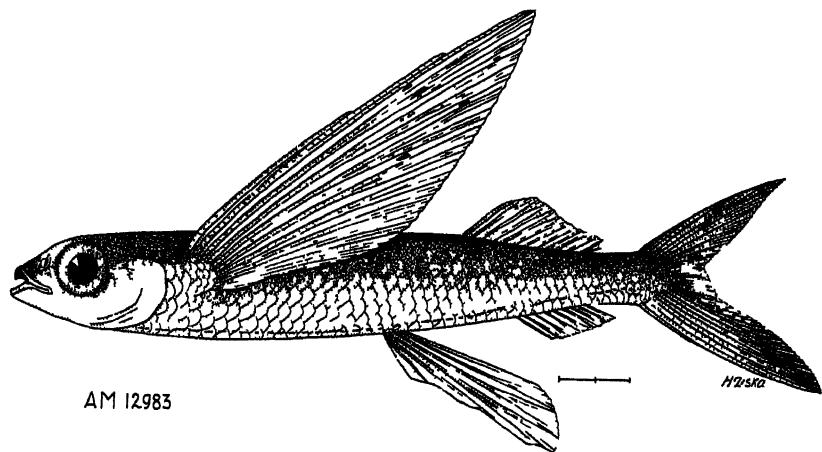
NEW PACIFIC FLYING-FISHES COLLECTED BY TEMPLETON CROCKER

By J. T. NICHOLS AND C. M. BRIDGER, JR.

Mr. Templeton Crocker obtained an excellent series of flying-fishes on the 1934-1935 cruise of his yacht 'Zaca' through the eastern Pacific, made in the interests of the American Museum of Natural History where they are now being studied. Three species of the genus *Cypselurus*, two adult and one a young form, are here described as new.

Cypselurus pitcairnensis, new species

SPECIFIC CHARACTERS.—Pectoral almost clean, somewhat darker, smoky along the front border and with a few scattered, small, oval, black spots on its interradial membranes, of the distal half, which are rarely absent and in one specimen more numerous along the hind edge. Anal (8) 9 or 10. Predorsal scales 27 to 30. Depth in standard length (specimens of 227 to 250 mm.), (5.2) 5.3 to 5.5; eye in head, (2.8) 3 to 3.4. Ventral origin equidistant from hind edge of eye to hind edge of pupil and base of caudal. Head blunt; teeth simple, very small; gill-rakers slender, 20 in all. (Figures in parentheses, for an aberrant specimen with no spots on pectoral)



AM 12983

Fig. 1. *Cypselurus pitcairnensis*, type.

DESCRIPTION OF TYPE.—No. 12983, American Museum of Natural History, from Pitcairn Island, collected by Templeton Crocker.

Length to base of caudal, 227 mm. (total 288 mm. est.). Depth in standard length, 5.4; head, 4.1; pectoral, 1.5 (to just past base of last dorsal ray); ventral, 3.2 (to 7th anal ray). Eye in head, 3.2; snout, 3.3; interorbital, 3.2; greatest width of body, 1.6; depth of peduncle, 3.2; its length, 2.4; longest dorsal ray (2nd), 2.2; anal ray (2nd), 3.5; lower caudal lobe (est.), 0.75. Base anal in base dorsal, 1.7.

Dorsal rays, $12\frac{1}{2}$; anal, 9. Scales, 43; predorsal, 27. Head broad; interorbital distinctly concave; eye large, distinctly infralateral.

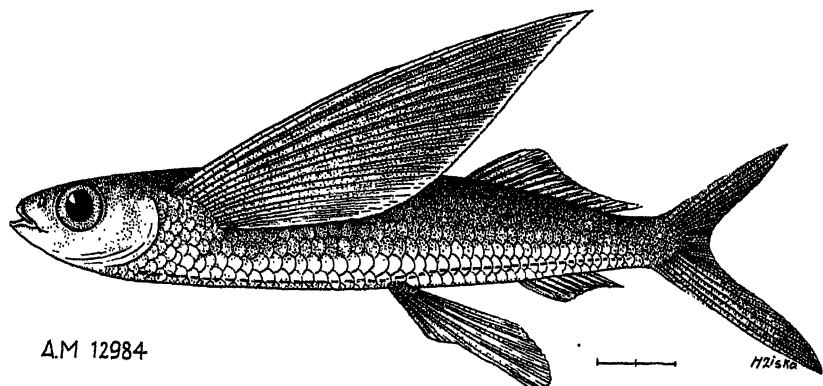
Dark above to about midline of side; white below; dorsal and anal hyaline, unmarked, the former slightly grayish; caudal uniform dusky; pectorals hyaline, light smoky along outer edge; one with 3, the other with 5 scattered spots on the distal half; ventrals hyaline with two longest rays somewhat dusky, especially proximally.

There are four other specimens with the same data.

Cypselurus angusticeps, new species

SPECIFIC CHARACTERS.—Pectoral almost uniform grayish, varying in tone but neither hyaline nor blackish, with a narrow pale posterior edge broadening at the tip and toward the axil of the fin. Anal 8 or 9. Predorsal scales 28 to 30. Depth in standard length (specimens 215 to 227 mm.), 5.1 to 5.7; eye in head, 3.3 to 3.6. Ventral origin equidistant from about or behind the middle of opercle and base of caudal. Head narrow and pointed for this genus, the snout equal to or slightly longer than eye. Teeth tricuspid; gill-rakers about $13 + 4$.

DESCRIPTION OF TYPE.—No. 12984, American Museum of Natural History, from Nengonengo Island, Tuamotus, November 5, 1934, collected by Templeton Crocker.



AM 12984

Fig. 2. *Cypselurus angusticeps*, type.

Length to base of caudal, 225 mm. Depth in this length, 5.1; head, 4.1; pectoral, 1.5 (to just past base of last dorsal ray); ventral, 3.8 (to 7th anal ray). Eye in head, 3.4; snout, 3.4; interorbital, 3; greatest width of body, 1.8; depth of peduncle,

3.3; its length (from dorsal axil), 2.1; longest dorsal ray (2nd), 2.5; anal ray (2nd), 3.7; lower caudal lobe (est.), 0.8. Base anal in base dorsal, 2.

Dorsal rays, 13; anal, 9. Scales (est.), 40; predorsal, 28. Head rather narrow and pointed; interorbital slightly concave; eye slightly infralateral.

Dark above to below midline of side, pale below; dorsal very pale grayish; anal white; caudal uniform dusky; ventrals pale becoming slightly dusky in the center of their base.

There are three paratypes of from 215 to 227 mm. in standard length, all from Tatakoto Island, also in the Tuamotus, which agree closely with the type in all essential particulars.

This species differs from *C. bahiensis* in anal count, dorsal and pectoral pattern; from *C. opisthopis* and *C. californicus* in the low scale count and pattern; from *C. oligolepis* and *C. xenopterus* in scalation and pectoral pattern; and from *C. simus* in number of predorsal scales and pectoral pattern. At present one can only speculate about the identity of the young bearded fishes going under the name, *C. narsei* and the non-bearded *C. nigripennis*, the numerical characters of which are not very unlike those of the present species and numerous others.

Cypselurus ventralis, new species

DESCRIPTION OF TYPE.—No. 13291, American Museum of Natural History, from 10° 01' S., 80° 05' W., March 4, 1935, collected by Templeton Crocker.

Length to base of caudal, 84 mm. (total 108 mm.). Depth in standard length, 6.26; head, 4.8; pectoral, 1.4; ventral, 2.35; lower caudal lobe, 3.1. Eye in head, 3.2; snout, 4.5; interorbital, 2.7; length of barbel, 1.2; width of body, 1.8; length of peduncle, 1.7; its depth, 3.2; highest dorsal ray (4th), 1.7. Anal base in that of dorsal, 1.4.

Dorsal rays, 13½; anal, 11. Scales (from over pectoral origin), about 50.

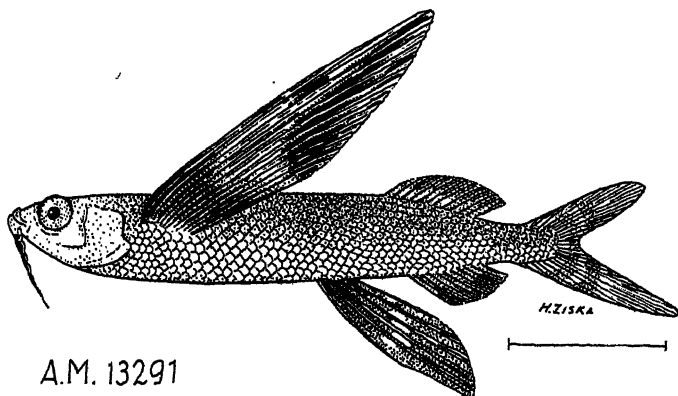


Fig. 3. *Cypselurus ventralis*, type.

Lower jaw strongly projecting; 2 mandibular barbels which reach preopercular edge, with a fluted membrane on their outer side only, becoming broader toward the base. Second pectoral ray branched, second and third the longest. Ventral origin equidistant from base of caudal and middle of preopercle. Anal origin about an eye's diameter behind that of dorsal. Pectoral reaching a little beyond last anal ray; ventrals to about middle of peduncle.

Color above more or less dusky becoming pale at about lateral line, lower parts pale to insertion ventrals, punctulate from there to middle of anal; barbels white at their base, becoming abruptly black on the proximal half, distally white again except for the narrow membrane which is black to the tip. Pectoral banded black and white—narrowly white at the origin, a broad white curved band crossing the fin and extending back along its outer margin much as in *C. furcatus* (Nichols and Breder, 1928, Zoologica, VIII (7), p. 447, Fig. 175), a broad curved white band cutting into the posterior margin of the fin, with black on the membrane making a few dark marks across it; ventrals rather uniform dusky, blacker toward the margin, with a row of paler oval interradiat spots crossing the fin near the middle. Dorsal and anal gray; caudal white with two faint gray cross marks on lower lobe.

In a specimen of 55 mm. from off Peru, the barbel equals the length of the head, its distal half including the membrane is white, and the black membrane on the proximal half much broader in comparison (half eye at its widest point). Specimens of about this size have the ventrals almost solid black in color.

This is a well-marked young flying-fish of which we have seven specimens in all, 39 to 84 mm. standard length, two from the type locality, four from 160 miles southwest of Port San Juan, Peru, and one from 7° 55' S., 83° 45' W. Its large black ventral fins are its most striking character and we are at a loss to know of what species it might be the young, unless of *C. xenopterus*, also taken off the Peruvian coast.

